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Art. I.—*Biography of Berzelius;* by Prof. H. Rose of Berlin.*

On the 7th of August, in the memorable year 1848, Berzelius died at Stockholm, after long and painful suffering, in his 69th year.

Distinguished men, who, during a long and active career, have enjoyed a great reputation, may have attained their celebrity in various ways.

When a teacher draws round him by his theoretical and practical instruction, or by an overpowering force of convincing eloquence, a circle of students whom, under his animating example, he inspires with enthusiasm for his doctrines,—or when, by an extraordinary talent for illustration, he renders even the most difficult branches of science accessible to the inquiring public, or by an able combination of known facts, he opens the way to the most fruitful ideas, such a man may contribute to the general diffusion of a scientific spirit, and otherwise exercise the most beneficial influence. But if at the end of his career, we examine whether a void has been left by his removal, it will often be found that science would have preserved, upon the whole, the same boundary if he had not labored for it. It may be that his influence upon science, although considerable, has been only indirect.

On the contrary, there are other men of special endowments, possessing in a high degree the talent for research, who recognize

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with marvellous penetration where to direct their investigations, and frequently, by discovering a few apparently very simple facts, clear up our views in a surprising manner, overthrow long-established prejudices, and advance science with gigantic strides.

It is rarely that men of the latter kind follow up and complete their scientific conquests. They generally content themselves with having shewn, by their discoveries, in what direction the study of details is to be pursued, and, after having pointed out the course and the method of filling up the gaps, resign the execution of the work to others.

Such a man was Humphry Davy. There are none who will not acknowledge that at the commencement of this century, chemical science received through him, by the discovery of the metallic nature of the alkalies, a most extraordinary impulse. But, however industriously and incessantly he occupied himself for years with experiments connected with his great discoveries,—experiments which led to the development of entirely new views, and enriched in a remarkable manner many branches of the science,—still he was unable to cultivate it in its entire extent. During his unfortunately too brief career, while advancing from discovery to discovery, he had neglected to give his attention to the details of the science; and when he attempted to combine chemical facts into a system, and to publish an elementary work on chemistry, it soon became evident that he was not fully equal to this undertaking; of his "Elements of Chemical Philosophy," only the first part of the first volume appeared.

But when a man possessed of the most remarkable powers of investigation enriches all branches of his science with the most important facts, distinguishes himself equally in empirical and in speculative researches, embracing the whole in a philosophic spirit, while, at the same time, bringing the details into complete systematic order, and, lastly, occupying the lofty position of a practical and theoretical teacher of an inquiring circle of pupils, he fulfills the highest requirements of his science in such a degree as to remain in after ages a brilliant type of his class.

Such was Berzelius. It is seldom that all these qualities are found united in one man in so high a degree of perfection as they were in him. In this respect, and in chemical science at least, he has been exceeded by none.

Since the death of Berzelius several biographies of him have appeared, especially in Sweden. All tell how in his childhood and youth, he had to struggle with care and poverty,—how he gradually overcame all obstacles,—how, in spite of his unpropitious external circumstances, he opened a way for himself, and entered upon the career for which he was destined.

But in an academic eulogium, it is before all things appropriate to point out the scientific merits of the deceased, to shew how

much science has been extended by him, and how great the loss it has suffered in his death.

It was exactly at the commencement of this century that Berzelius first appeared as an independent investigator. Volta had just constructed the electrical pile which bears his name, and its astonishing effects occupied in a high degree the attention of the men of science of the time. The unexpected chemical phenomena produced by the pile excited the interest of chemists fully as much as that of physicists, and induced them to multiply experiments with this remarkable apparatus. The first investigation made public by Berzelius was upon the effects of the electrical pile upon saline solutions. In the year 1803, there appeared in *Gehlen's Neu. Allg. Journal der Chemie* an important paper on this subject, the joint production of Berzelius and Hisinger. However manifold and remarkable were the results which had hitherto been obtained with the Voltaic pile with regard to chemical decomposition, still no one had succeeded in discovering the laws of these phenomena. Berzelius was the first to find the thread which could lead with certainty through this labyrinth of complicated phenomena. He shewed that substances which are liberated at one pole, have in other respects a certain analogy; that all combustible bodies, alkalies and earths, were carried to the negative pole, and on the contrary, oxygen, acids, and highly oxydized bodies to the positive pole. But what particularly proves the admirable sagacity of Berzelius is the circumstance that he did not allow himself to be led astray by the appearance of the same body, sometimes at the positive, sometimes at the negative pole, as, for instance, the appearance in the decomposition of nitric acid, of nitrogen at the negative, in the decomposition of ammonia at the positive pole. It was, on the other hand, clear to him even at that time that the antitheses between the constituents of a chemical compound were only relative, and that one and the same body may behave as a base to a second, and as an acid to a third.

Three years after Berzelius had made public this important investigation, in 1806, Davy developed similar views in a memoir upon some effects of electricity, which has become very famous. He extended the experiments considerably, prosecuted them with very ingenious apparatus, by means of which he succeeded in disproving many erroneous views as to the effects of the electric pile, which had at that time become general. He particularly explained the peculiar and remarkable mode of the transmission of substances from one vessel into another; but in his memoir he does not make any mention of the views of Berzelius, which correspond with his own; and Pfaff, who translated Davy's paper for Gehlen's Journal, felt it necessary to remark that three years previously Berzelius and Hisinger had made known

all the fundamental principles which Davy now brought forward as entirely new.

In 1807, Davy received the prize of 3000 francs, offered by the Emperor Napoleon for the best set of experiments made during that year on the subject of galvanism. The merits of Berzelius and Hisinger were unnoticed.

After Davy had made known, in October, 1807, the important discovery of the metallic nature of the alkalies, and thus excited in a high degree the attention of scientific men, Berzelius also occupied himself with the separation of the alkaline metals by means of the voltaic pile. In the spring of 1808 he formed the happy idea at the same time with Seebeck who was then living at Jena, of employing mercury as the negative pole in the decomposition of the alkalies, which were placed at one side in contact with it in a moist state, and at the other in contact with the positive conducting wire. Berzelius made these experiments in conjunction with Pontin. In this way he succeeded in obtaining amalgams not only of potassium and sodium, but also of calcium and barium. Davy had in vain attempted to exhibit the metals of the alkaline earths by the methods which had fortunately yielded him the metals of the fixed alkalies; he could only obtain barium, strontium, and calcium, from amalgams prepared according to the method communicated to him by Berzelius.

But the most surprising results were those which Berzelius obtained in decomposing ammonia by the voltaic pile, likewise employing mercury as the negative pole. He obtained the ammoniacal amalgam, respecting the nature of which he even then entertained correct views. He had employed in this experiment caustic ammonia, while Seebeck, at the same time, and in a manner quite similar, obtained the amalgam with moistened carbonate of ammonia. Tromsdorf also, in conjunction with Göttling, obtained this amalgam at about the same time as Seebeck.

While Berzelius thus occupied himself at the commencement of his scientific career in experimenting with the voltaic pile, he was also led to form a theory of this pile in some respects at variance with that of its famous discoverer. Volta, in constructing his theory, had not taken into account the chemical activity of the pile, regarding that merely as an effect, and not as the cause of electrical action. Berzelius as a chemist put forward the opposite view, that the electricity of the pile results from the chemical action of the moist conductor and the positive metal. This chemical theory of the pile found great support, and it is still entertained by many distinguished physicists, and among them even by Faraday. Berzelius, however, unbiassed by prejudice, candidly returned again to the original view of Volta, after having convinced himself of its accuracy by a lengthened series of experiments. Long previously to the introduction of the

batteries of Daniell and Grove, he had constructed one of zinc, copper, and two liquids, in such a manner that the zinc was not attacked by the liquid in contact with it, while the copper was briskly oxydized by the other. If now the oxydation of one of the metals were the cause of the electricity, the copper would have been positive, and the zinc negative; consequently the poles of the pile would be reversed. Before the circuit was closed, the copper was violently oxydized and dissolved; but, when the poles were connected, this action ceased immediately, and metallic copper was precipitated from the liquid upon the copper plate. This experiment rendered it obvious to Berzelius that chemical activity could not be the cause of the electrical phenomena; for the former ceased when the poles were connected, and the direction of the current was that indicated by the principle of contact-electricity. These experiments were instituted by Berzelius before many physicists had commenced to adopt the chemical theory of the pile, and especially long before Fechner endeavored to prove the truth of the contact theory by his ingenious experiments.

It was not, however, these experiments with the voltaic pile which alone, or even principally, occupied the attention of Berzelius at the commencement of his career. At the instigation of Hisinger, who had a particular partiality for the chemical part of mineralogy, and to whom, as a geologist and mineralogist, Sweden owes so much, Berzelius early directed his attention to the quantitative analysis of minerals. He candidly admitted in after years, that in the first instance, when the law of combination in simple definite proportions was not yet established, he did this chiefly on Hisinger's account. But the very first result of an investigation of this kind, carried on in conjunction with Hisinger, was of the most brilliant kind: it was the discovery of a new metal, Cerium, during the year 1803, in the so-called tungsten of Bastnäs, near Riddarhyttan in Westmanland.

It must be admitted that the discovery of a new metal is often the result of mere chance. But it is not every chemist who is able, even when greatly favored by chance, to recognize in a substance obtained in the course of an investigation, a hitherto unknown element. This requires a perfect knowledge of the known elements such as can be acquired only by many laborious investigations and long experience. For this reason new elementary bodies are not easily discovered by young chemists, not even by those of high talent. The discovery of cerium, which Berzelius made in his twenty-third year, shows therefore the great and rare sagacity which he displayed even in his first investigations.

Klaproth investigated the tungsten of Bastnäs simultaneously with Berzelius and Hisinger, and declared that the oxyd which

it contained in combination with silica was new. But he overlooked its metallic nature, and although he obtained it of a reddish-yellow color, regarded it as an earth, which he called Ochroit earth. The investigation of Berzelius and Hisinger was evidently carried out with more precaution than that of Klaproth. Not only did the latter overlook the partial solubility of the oxyd in solutions of alkaline carbonates, he did not even remark the disengagement of chlorine on treating the ignited oxyd with hydrochloric acid. It was not until afterwards, when, for the second time, he made known his investigations upon cerite in the fourth volume of his "Beiträge zur chemischen Kenntniss der Mineralkörper," which did not appear until 1807, that he mentioned the evolution of oxy-muriatic gas on treating the ignited oxyd with muriatic acid, still, however, without attaching to the fact any great weight. Berzelius and Hisinger, on the contrary, justly considered this of very special importance, as unequivocally pointing out two very different stages of oxydation, at that time one of the principal means of distinguishing between metallic oxyds and earths, which were then regarded as simple bodies. Gehlen also directed attention to this point in a remark upon the paper of Berzelius and Hisinger. Further, he was fortunate enough to accomplish, with the aid of Hjelm, the reduction of the oxyd, and to obtain the metal in an isolated, although not in a melted state.

When Berzelius subsequently undertook the determination of the equivalent weights of almost all the elementary bodies by means of a long series of experiments, he resigned the estimation of the equivalent of cerium to Hisinger, and did not occupy himself more specially with this metal. Thus probably the discovery of the oxyds of two other metals, accomplished by Mosander, thirty-six years after that of cerium, escaped him.

Besides the examination of cerite, Berzelius undertook at that time the investigation of other new and interesting minerals. But during the first period of his scientific activity he was chiefly occupied in an entirely different branch of chemistry. Berzelius's first avocation in the world, by which, poor as he was, he had to earn his livelihood, was that of physician. He naturally sought in this profession for those occupations especially in which sound chemical knowledge was indispensable. Thus he examined several of the natural mineral waters of Sweden, and these investigations, although inferior to those of a similar nature which he subsequently carried out, especially that of the Carlsbad water, still in every respect belong to the best of their time. In consequence of these investigations he established in Stockholm a manufactory for preparing these waters artificially.

But it was quite natural that as physician he should be induced to take up the study of animal chemistry. What he achieved in

this branch of chemistry, and indeed within a short space of time, is extraordinary, and opened as it were an entirely new field in this science.

Before Berzelius's time, animal chemistry was treated nearly in the same manner as that of inorganic bodies; the constituents of the animal body were arranged in certain classes, and described merely as objects of chemical decomposition, perhaps with a few general remarks as to their functions in animal life. This mode of treatment is, in a scientific point of view, totally valueless. Berzelius endeavored to combine anatomical with chemical investigations, so as to tend to a common end, in order in this to give to experiments a higher scientific connection, and to direct the attention of the chemist to the physiological aspect of the subject.

In this spirit he investigated almost all parts of the animal body, solids and fluids, certainly only qualitatively, as at the commencement of this century there did not exist the most remote knowledge of those methods for the quantitative elementary analysis of organic substances, which have only been subsequently brought to a high state of perfection, especially by the labors of Berzelius himself, and afterwards by those of Liebig. But the investigations in animal chemistry carried out at that time by Berzelius, remain as examples for imitation at the present day, and have never been excelled. It is scarcely credible how much the very accurate results of his investigations differ from those which were obtained at the same time by other chemists, and solely because their investigations were undertaken from a one-sided point of view, and without any high scientific purpose. Beside Berzelius, the only chemist of that time who entered upon these investigations from a physiological point of view, was Fourcroy; but his results vary the most widely from those of Berzelius, since from scattered, uncertain, superficial, and often wholly incorrect observations, he drew general and extended inferences, although certainly in a very ingenious manner, and by his attractive illustration led the way to the greatest errors. In order to recognize the high superiority of Berzelius over Fourcroy in this respect, it is only necessary to compare the investigations of the latter upon blood, especially its red coloring matter, with that instituted by Berzelius on the same subject only a short time afterwards.

Berzelius made known his investigations in animal chemistry in the form of lectures, the first of which appeared in 1806; the second in 1808. Besides this, the most important examinations of separate animal substances appeared in the *Afhandlingar i Fysik, Kemi och Mineralogi*, and in Gehlen's Journal. He gave a masterly review of his labors in animal chemistry, compared with what was previously known on the subject, in a speech de-

livered upon the occasion of his vacating the presidentship of the Stockholm Academy of Sciences. It is there the custom annually to select from among the members of the Academy, a new president, who, in vacating his office, must deliver a scientific dissertation, which is printed. This is, indeed, frequently the only means of compelling members to publish their researches.

Within the first period of Berzelius's scientific activity, two other investigations were carried out, which for that time were of the greatest importance. They were on the reduction of silica, and the composition of cast iron.

Although Berzelius had succeeded in obtaining the metals of the alkaline earths in combination with mercury, by means of the voltaic pile, he was unable to separate in a similar manner the radical of silica from its oxygen. In order, however, to satisfy himself that silica had a composition similar to the earths, he instituted a series of interesting experiments for the purpose of uniting the radical of silica with metals, especially iron, by mixing iron filings with carbon and silica, and exposing the whole to an intense heat, by means of which he obtained reguli which contained, together with silicium, carbon. He then found approximately the quantity of oxygen present in silica, by estimating the quantity of iron and carbon, the latter certainly by a somewhat unsafe method. The remark which he makes at the close of his paper, published in 1810, is well worthy of notice. After having described his numerous experiments on the quantity of oxygen in silica, which throughout had not given very closely corresponding results, he concludes with these words: "I consider it moreover as unimportant to determine with precision the per-centage of oxygen or radical in silica, since I am unable at the present time to perceive either theoretical or practical advantage to be gained by this accuracy." A few years later he would not have expressed himself in this manner.

Another investigation important for this period related to the composition of crude iron. At the commencement of the present century, singular ideas of its composition had been formed. It was supposed that oxygen generally existed in iron associated with carbon; and, indeed, an Essay, in which the quantity of oxygen in crude iron was supposed to have been demonstrated, obtained a prize. This view was principally founded upon the circumstance, that on treating crude iron with non-oxydizing acids, less hydrogen was obtained than with an equal weight of malleable iron. Berzelius proved that in this case an oleaginous hydrocarbon was produced, and shewed, with the greatest certainty, that there could not possibly be any oxygen in crude iron. He determined the quantity of carbon by converting it into carbonic acid. Subsequently he attempted to estimate the carbon directly, by dissolving the iron through the agency of chlorid of

silver or chlorid of copper. At that time attention had not been directed to the difference between the chemically combined and the mechanically intermixed carbon or graphite. This was not recognized until subsequently by Karsten, who also proved that graphite consisted of carbon alone, and contained no iron. While prosecuting the analysis of crude iron, Berzelius made several interesting observations; thus, besides others, he was led to propose the use of benzoic acid as a means of separating peroxyd of iron from protoxyd of manganese and magnesia, instead of the then more costly succinic acid recommended by Gehlen. He further showed, that on treating crude iron with nitric acid, an extractive substance, having an almost perfect resemblance to the extract of vegetable mould, is produced from the carbon of the iron. He also accidentally discovered during this analysis the interesting double salt of persulphate of iron and sulphate of ammonia, the composition of which he was the first to determine qualitatively with accuracy. This salt he at first regarded as alum, on account of the form, though he found no alumina in it. He moreover pointed out that the silica which he obtained after the solution of the iron did not exist in the crude iron as such, but as silicium. However important the various facts ascertained during this investigation might be, Berzelius was still not fully satisfied with the results obtained, since he could not rely upon the correctness of the method which he had employed for the quantitative determination of carbon or of magnesia, whose presence in the solution of crude iron he had proved. On this account, he published his investigation under the modest title of *Attempt to Analyze Crude Iron.*

I now come to the most important period of Berzelius's scientific activity. His previous achievements were owing more to circumstances than to any leading ideas. He was, to a certain extent, incited by the scientific interest of the time to take up the galvanic investigations, by the friendly intercourse with Hisinger to enter on the chemico-mineralogical, and, finally, by his professional position to engage in those on animal chemistry. Towards the end of the first decennium, however, he was led, especially by the investigations of Davy, to study the simple chemical proportions in which bodies generally combine with each other, and from this time applied all his energies to this subject. The activity which he now developed, under the guiding influence of a great idea, was in fact gigantic; for, after the lapse of only a few years, he established, to the amazement of his contemporaries, the complete theory of combining proportions, a subject the details of which he labored constantly in perfecting and improving during the remainder of his life. It may be safely affirmed, that it was only from this time that chemistry became in truth one of the exact sciences; for from the collection of em-

pirical facts which had hitherto borne the name of chemistry, the universal law now first developed itself, according to which bodies enter into chemical combination.

Berzelius is not, properly speaking, the first discoverer of the doctrine of chemical proportions. It generally happens in all sciences that great laws are not suddenly discovered by one investigator, but are gradually recognized.*

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During the previous century chemists who had occupied themselves with the phenomena of the so-called chemical affinity, made several observations which incontrovertibly proved that there was a strict uniformity and order in the chemical combinations of bodies. These men were especially Bergmann in Sweden, Kirwan in Dublin, Wenzel in Dresden, and above all, Richter in Berlin. The latter two had indeed come to the conclusion, that acids and alkaline bodies must combine in definite proportions, because in the double decomposition of neutral salts neutral products are formed.

But when it was attempted to prove this preconceived law by demonstrating the composition of the decomposed salts, the proofs brought forward were either altogether insufficient or very incomplete,—a circumstance resulting from the then imperfect methods of separation, by means of which it was impossible to attain to such accurate analyses that the calculated results of the decomposition of two neutral salts could correspond with experiment.

The attention of chemists was soon diverted from this subject when in the eightieth year of the past century the theories of Lavoisier gave a new direction to the whole science. The attack upon the phlogistic theory, and the establishment of the antiphlogistic system, took undivided possession of all thinking minds. None had time to occupy themselves with any other than the qualitative changes which bodies underwent by their mutual decomposition. It was also necessary that Lavoisier's theory should have gained a complete ascendency before the doctrine of simple chemical proportions could be fully recognized and appreciated.

In addition to this the development by Berthollet, one of the most gifted chemists of the time, of a theory apparently in total opposition to that of definite chemical proportions, tended to withdraw attention from the latter. Berthollet endeavored to prove, that bodies which possess an affinity for each other are capable of combining in all proportions between certain maximum and minimum quantities, and that when the combination took place in definite proportions this was owing to special circum-

* Owing to the indistinctness of the MS., a long sentence, is here omitted. The want of it, however, does not affect the sense of the text.

stances, particularly the power of crystallizing or of cohering in any form, in consequence of which compounds could separate from a solution, as precipitates or crystals; or else owing to the expansion taking place on passing into the gaseous state, by which they removed themselves from the sphere of action of solid or fluid bodies. The most important law established by Berthollet was, however, that of the so-called chemical mass, according to which the deficiency of a body in chemical affinity may be replaced or compensated for by increasing its quantity: and it is indisputable that this law, although it has latterly been more and more forgotten, is perfectly correct.

The first of these principles, established by Berthollet, viz: that all chemical combinations are possible between a certain maximum and minimum, and in indefinite proportions, was immediately disputed by Proust, who endeavored, by means of many ingenious experiments, to shew that every chemical combination takes place in definite proportions, and that between it and the nearest allied combination there is a certain interval within which there is no intermediate stage.

Berthollet's views were at that time apparently supported by the numerous erroneous representations of the composition of the most important compounds. Likewise the experiments which he made, or caused to be instituted, in order to disprove the assertions of Proust were far from being adequate. Proust's experiments were certainly in most cases more correct, although not in such a degree as to place his views beyond all doubt.

Sometime after the analogy in composition between the alkalies and metallic oxyds was proved by Davy's important discovery, the attention of Berzelius was also drawn to the quantitative relations in which bodies combined with each other. It was the chemical nature of ammonia, which, in the first instance led him to enter upon this gigantic investigation. After the discovery of oxygen in the alkalies, the conjecture that all saline bases, and consequently ammonia, contained this element, was not unnatural. This view received a still greater probability by the discovery of the ammoniacal amalgam.

Berzelius now commenced a series of investigations for the purpose of determining the quantity of oxygen in alkalies and earths, by oxydizing with water the basic metal in a weighed quantity of the amalgams which he first learned how to prepare, then combining the oxyd produced with hydrochloric acid, and in accordance with the then received views of the composition of chlorids, found the quantity of acid in the salt, and by the loss the quantity of oxygen in the base itself.

On subjecting ammonia to the same process he was not able either to isolate the ammoniacal metal, or to combine it with the mercury in such a quantity as to obtain a result. He then en-

deavored to attain his purpose by the direct determination of the oxygen supposed to exist in ammonia. He wished to make an application of the discovery made by Bergmann in his work "De diversa phlogisti quantitate in metallis," that when one metal separates another in a metallic state, from solution in an acid, the metal suffering solution yields precisely the same amount of phlogiston as the one previously dissolved requires in order to assume the metallic form; that a certain acid in dissolving metals expels equal quantities of phlogiston from the different metals; or to express the same in the language of the antiphlogistic system, that when a certain quantity of any acid combines with different metallic oxyds, forming neutral salts, the oxyds must contain an equal and invariable quantity of oxygen.

But in order to be able to apply this law of Bergmann with perfect certainty, unassailable proofs of its perfect accuracy were necessary. Those which Richter had given could not be regarded as at all admissible. Berzelius now compared his analyses of potash, soda, and lime with Bucholz's analysis of oxyd of silver, and that made by my father of oxyd of mercury; and he found in fact that the quantity of these bases which saturate the same quantity of hydrochloric acid, forming a neutral salt, contained, with very slight deviations, the same quantity of oxygen. But when he came to examine other metallic oxyds and combinations with muriatic acids, the results obtained were so much at variance (perhaps on account of many erroneous premises which he assumed) with the principle of Bergmann, that he was compelled to ascribe the want of correspondence either to his own want of dexterity in experimenting, or to an erroneous application of Bergmann's laws. Since, however, careful repetition of his experiments gave results corresponding closely with those first obtained, he began to entertain doubts of the correctness of Bergmann's law. When, again, he subsequently found that metallic sulphurets, on being perfectly oxydized by nitric acid, yielded neutral sulphates of the oxyd, without any excess either of metallic oxyd or sulphuric acid, he felt compelled to return again to the opinion which he had abandoned. At the same time he observed that metals unite with double (exactly or very nearly) as much sulphur as oxygen, and that by a simple rule of three, the capacity of combination of any metal for sulphur may be calculated from its oxyd, or the contrary. He was now again led to study the mutual decomposition of neutral salts, and he finally succeeded in practically demonstrating, from the composition of several salts, the neutrality of those resulting from their decomposition.

I feel myself justified in mentioning the following circumstance, although somewhat of a personal character. Berzelius, after being unable to prove by calculation the neutrality of salts

mutually decomposing each other, while basing his calculations upon the data of incorrect analysis, was often nearly abandoning the perplexing subject, but was induced by a paper of my father, upon the relation of the constituents of neutral muriates (published by him in 1806, a year before his death, in the 6th volume of "*Gehlen's neues Allg. Journal*," p. 22), to persevere. My father had, in the first place, by at least one example, practically demonstrated, that by the decomposition of two neutral salts, muriate of baryta and sulphate of soda, according to his own analysis of them, and of the two salts proceeding from the decomposition, and by calculation, results were obtained, which proved that the neutrality could not be disturbed.

Berzelius now considered it necessary, in order to attain to certain results, to investigate anew the composition of the most important compounds with extreme care, repeating the analyses several times before venturing to employ their results in the extension of his views. He remarked very justly, that, on account of the unchangeable neutrality of two salts decomposing each other, it was only necessary to analyze, with sufficient accuracy, all salts formed for example by sulphuric acid, and all those whose base is baryta, in order to be able, by a simple rule of three, to calculate the composition of all other salts, because these two series contain the three numbers which are necessary in order to find the fourth.

Berzelius now ventured upon an herculean task, which he prosecuted for many years with the most indefatigable industry, and for a long time without any help. He re-examined every important chemical compound with the most admirable care and exactness. In this work, especially, he displayed rare talent, selecting, with the most extraordinary acuteness, those bodies which were the best adapted for investigation. He published an account of his labors, or rather the commencement of them in the third part of the "*Afhandlingar i Fysik, Kemi och Mineralogi*" for 1810. They first appeared in German in 1811, in *Gilbert's Annalen*.

In these investigations, theory was constantly the touch-stone employed to test the accuracy of the results, to attain which he was frequently obliged to vary his experiments almost endlessly. He was, in the first instance, compelled to improve the analytical methods, and to abandon many of those in use at that time, and by this means he was gradually led to those views which are now received by all chemists.

The most distinguishing characteristic of Berzelius's mode of working was, that with the most insignificant means at his command, he still succeeded in obtaining the most brilliant results. When he entered upon his great investigation, he was in possession of very small pecuniary means, he was in a condition almost

of want, and without public support, which, considering the isolated situation of Sweden, must have been especially depressing and unfavorable. The difficulties against which he had then to contend were, in fact, enormous. At that time it was not possible to purchase in Stockholm pure reagents, as in Berlin; scarcely any chemical manufactories existed in the country, and to import reagents from abroad, for instance from Germany, was often scarcely possible, on account of the difficulty of communication, especially during the war, and at all times it was expensive and tedious. I have myself been a witness how Berzelius, even during the winter of 1820, while carrying out his important investigation of ferrocyanogen and ferrocyanid of potassium (which had long been procurable in Germany for a small sum per pound), was obliged to prepare this salt by the gramme, and indeed from a very bad material, the very impure Prussian blue of the shops. He was obliged to distil the spirit, the use of which in lamps he introduced, from ordinary brandy, and to prepare the most important acids himself, or to purify those which could be bought.

But it seems as if it was precisely those obstacles which would have discouraged and overcome any ordinary mind, that urged him on more perseveringly in his course. This is, moreover, a circumstance which has often occurred, and especially in Sweden. I need only call to mind Scheele, who almost made impossibilities possible.

Berzelius, in the first place, altered the methods of Klaproth, which at that time were the best, in so far especially that he employed considerably smaller quantities. The usual quantity operated upon by Klaproth and other chemists was rather more than five grammes; Berzelius never took more than two or three grammes, generally less, determining this quantity, of course, according to the nature of the constituents of the body to be examined. By employing more delicate balances, which Berzelius first introduced into use in chemistry, and by adequate care, results are obtained with a small quanity, which are at least quite as accurate, while they are obtained in much shorter time.

I had the good fortune during my youth to assist the meritorious Klaproth in his chemical investigations, though only during his later years, in the summer of 1816, when his labors were often interrupted by repeated attacks of illness. I was therefore enabled, while afterwards for several years in the laboratory of Berzelius, to compare the different manner in which Klaproth and Berzelius worked. Their methods had exactly the same relation to each other as the respective accuracy of their results.

The spirit-lamp, with double draught, was likewise introduced into use by Berzelius. Formerly the ignition even of the smallest quantities of a substance was effected over a charcoal fire. He was also the first to make use of the small platinum crucible,

in which, substances could be both ignited and weighed, and by the use of which considerably greater accuracy was insured, and the absorption of moisture as far as possible prevented. The filter containing the precipitate was always burnt when possible, and the ignited substance weighed together with the ash of the paper; a saving of time and trouble for which we are indebted to Mr. d'Ohsson, who worked in Berzelius's laboratory. It was on this account that a paper was employed which left after combustion but a very minute quantity of ash, and which was made of excellent quality in Sweden, because there are springs there rising through granite, the water of which is almost free from fixed substances. The general introduction of this Swedish paper, to the manufacture of which Berzelius paid great attention, is also owing to him.

The use of appropriate funnels, &c., as well as an immense number of other convenient applications originating with him, have contributed to render the results of analyses much more exact, and have much simplified the methods themselves.

Berzelius had moreover—and it is no slight merit—transferred chemical investigations in which charcoal fires were not necessary, from the damp kitchen, or cellar-like cold laboratory, into the comfortable dwelling-room. The present generation have scarcely an idea of the discomforts which were then connected with chemical researches. It certainly required no little scientific enthusiasm, during the severe winters of our northern climate, to remain in a place where there was the greatest absence of comfort, and which was even prejudicial to the health. But it was at that time thought that a laboratory with a stone floor was indispensably necessary even for trifling chemical operations.

The small caoutchouc tubes, by means of which experiments with gases may be so easily and safely conducted, and which, indeed, alone render many inquiries possible, were early employed by Berzelius in his investigations. Whoever has in former times attempted the collection of a gas will remember the unpleasantness of working with brittle glass tubes, and how easily an experiment failed from the slightest want of care. It was Berzelius who first rendered glass tubes, as it were, flexible, and they could then be employed in constructing the most complicated apparatus.

Possessing only the most scanty means, he was led to all these improvements by actual necessity. He took advantage of every opportunity to perfect himself in mechanical art. He was master of glass-blowing, which he learned from a travelling Italian; he was familiar with turning, glass-grinding, and other arts. He made the greater part of his own instruments; and notwithstanding the isolated position of his native country, was thus enabled to construct those ingenious forms of apparatus by means of which he so infinitely advanced the study of chemistry.

(*To be continued.*)

ART. II.—*Chemical Investigation of Remains of Fossil Mammalia;* by FRANCIS V. GREENE, M.D.

AT the request of Dr. F. A. Genth, I have made in his laboratory a chemical investigation of several fossil remains, collected by D. D. Owen, M.D., in his late survey of Nebraska Territory; the specimens having been kindly furnished me by Dr. Jos. Leidy, from the collection of the Academy of Natural Sciences. The specimens consisted of a portion of bone from a Titanotherium, the enamel and dentine from a tooth of the same animal, and a portion of the tibia of the Archæotherium.

The general outline of the methods used is as follows:

The finely powdered substance, being always dried over sulphuric acid, was dissolved (according to H. Rose's method for the determination of phosphoric acid), in nitric acid, and after adding mercury in sufficient quantity to combine with the phosphoric acid, evaporated to dryness in a water-bath; afterwards it was moistened with water, and again evaporated to dryness; this operation being repeated until no odor of nitric acid could be observed at the temperature of the water-bath. To this dried mass water was now added. The insoluble portion consisted of nothing but phosphate and basic nitrate of mercury (except in one analysis, in which iron existed in a determinable quantity); the solution contained fluorid of calcium with the other constituents in the form of nitrates. The insoluble portion was separated by filtration, and, after being washed and thoroughly dried, was fused with carbonate of soda, with all the precautions mentioned by Rose. The fused mass consisting only of phosphate of soda and the excess of carbonate of soda, dissolved therefore completely in water, except in one instance, in which a portion of the iron remaining undissolved was filtered off, and determined in the usual manner. The watery solution was acidulated with hydrochloric acid and the phosphoric acid precipitated in the ordinary way by sulphate of magnesia and chlorid of ammonium.

From the solution containing the soluble nitrates and fluorid of mercury, the mercury was precipitated by chlorid of ammonium, and the filtrate from the calomel precipitated by carbonate of ammonia. As carbonate of lime and fluorid of calcium are not quite insoluble in ammoniacal salts, a small quantity of each was always deposited on evaporation of the filtrates from which they were separated by filtration and added to the other portions of carbonate of lime and fluorid of calcium. This precipitate was ignited, and an excess of acetic acid added, which dissolved the carbonate of lime, leaving the greater portion of the fluorid of calcium; but, as fluorid of calcium is soluble to a certain extent in acetic acid, the whole was evaporated to dryness to get rid of the free acetic acid, and the dry acetate of lime, dissolved

in boiling water, and filtered from the insoluble fluorid of calcium. Finding that it always contained a small quantity of silicic acid, the mixture, after being weighed, was treated with hydrochloric acid, which left undissolved the silicic acid, the quantity of which was determined and subtracted from the previous weight, thus leaving the exact quantity of fluorid of calcium.

The solution from the carbonate of lime containing only magnesia and the alkalies, was evaporated to dryness to drive off the ammoniacal salts, and the residue dissolved in sulphuric acid, the excess of which was also driven off by heat. The dry mass was dissolved in water, and acetate of baryta added to convert the sulphates into acetates. The filtrate from the insoluble sulphate of baryta, was now evaporated to dryness and heated in order to convert the acetates of baryta, magnesia, and the alkalies into carbonates, which were then treated with boiling water, and the soluble alkaline carbonates thus separated from the insoluble carbonates of magnesia and baryta. This latter mixture was then treated with dilute sulphuric acid, and from the filtrate, magnesia afterwards separated as phosphate of magnesia and ammonia. The carbonates of the alkalies were converted into and weighed as chlorids, and afterwards separated by bi-chlorid of platinum.

A new portion was taken for the remaining determinations.

This was dried at 220° until the weight became constant; the loss giving the quantity of water. The anhydrous substance was then heated in an open crucible until all the organic matter was burned off, and then moistened with carbonate of ammonia, as it was supposed that the high heat might have driven off a portion of the carbonic acid. The difference of weight gave the quantity of organic matter. Carbonic acid was determined in the usual manner from the loss of weight after treating with nitric acid. The nitric acid did not dissolve a small quantity of silicic acid, the weight of which was ascertained and added to that of the portion previously extracted. From the filtrate sulphuric acid was precipitated as sulphate of baryta.

The following are the data of the analyses:

1. *Bone of Titanotherium.*

I. 1·9136 grammes gave:

1·0200	grs.	of pyrophosphate of magnesia for determination of phosphoric acid.
0·0018	"	silicic acid.
0·0340	"	sesquioxyd of iron.
0·0137	"	fluorid of calcium.
0·0175	"	pyrophosphate of magnesia for determ. magnesia.
1·6995	"	carbonate of lime.
0·0504	"	mixed chlorids of potassium and sodium.
0·0127	"	platinum = 0·0096 chlorid of potassium.

II. 1·5776 grammes gave:

0·0090	grs.	of sulphate of baryta and silicic acid, which contained:
0·0086	"	sulphate of baryta, and
0·0004	"	silicic acid.
0·0404	"	sulphate of baryta for determination of sulphuric acid.
0·0645	"	carbonic acid.
0·0323	"	water.
0·0896	"	organic matter.

2. *Tooth of Titanotherium.*

a. Enamel.

I. 1·6226 grammes gave:

0·9966	grs. of	pyrophosphate of magnesia for determination of phosphoric acid.
0·0079	"	silicic acid.
0·0016	"	fluorid of calcium.
0·0099	"	pyrophosphate of magnesia for determination of magnesia.
1·4999	"	carbonate of lime.
0·0454	"	mixed chlorids of potassium and sodium.
0·0081	"	platinum = 0·0061 chlorid of potassium.

II. 1·8518 grammes gave:

0·0545	grs. of	sulphate of baryta for determination of sulphuric acid.
0·0023	"	silicic acid.
0·0586	"	carbonic acid.
0·0116	"	water.
0·0470	"	organic matter.

3. *Tooth of Titanotherium.*

b. Dentine.

I. 2·0083 grammes gave:

1·1318	grs. of	pyrophosphate of magnesia for determination of phosphoric acid.
0·0129	"	silicic acid.
0·0582	"	fluorid of calcium.
0·0297	"	pyrophosphate of magnesia for determination of phosphoric acid.
1·7829	"	carbonate of lime.
0·0356	"	mixed chlorids of potassium and sodium.
0·0095	"	platinum = 0·0072 chlorid of potassium.

II. 1·1643 grammes gave:

0·0509	grs. of	sulphate of baryta for determination of sulphuric acid.
0·0018	"	silicic acid.
0·0330	"	carbonic acid.
0·0245	"	water.
0·0310	"	organic matter.

4. *Tibia of Archæotherium.*

I. 2·1037 grammes gave:

1·0243*	grs. of	pyrophosphate of magnesia for determination of phosphoric acid.
0·1070	"	fluorid of calcium.
0·0668	"	pyrophosphate of magnesia for determination of magnesia.
1·7639	"	carbonate of lime.
0·0714	"	mixed chlorids of potassium and sodium.
0·0122	"	platinum = 0·0092 chlorid of potassium.

II. 1·7400 grammes gave:

0·0345	grs. of	sulphate of baryta and silicic acid, which contained:
0·0300	"	sulphate of baryta,
0·0045	"	silicic acid.
0·0814	"	sulphate of baryta for determination of sulphuric acid.
0·0395	"	carbonic acid.
0·0343	"	water.
0·0711	"	organic matter.

1. *Bone of Titanotherium.*

Compact, with subconchoidal fracture. Tough. Hardness 4·5. Sp. Gr. 2·810 (at 20° C.) Lustre resinous. Color brown. Opaque. On heating gives off ammoniacal water, together with the odor of burned horn. Contains:

* This quantity is rather too small, owing to a slight loss in the phosphoric acid; therefore in the analysis the loss was calculated as phosphoric acid.

Fe	Mg	Ca	CaFl	Ba	Na	K	Si	S	P	C	H	Org. Mat.
1·777	0·348	49·837	0·716	0·359	1·134	0·317	0·135	1·067	34·148	4·088	2·048	5·682=101·656

with a trace of manganese and chlorine: which may be considered as

$2Fe_2O_3, PO_5$	2·821	$3CaO, SiO_3$	0·382
$3MgO, PO_5$	0·770	CaO, CO_2	9·315
$3CaO, PO_5$	69·685	CaO	6·605
$2NaO, PO_5$	1·415	CaFl	0·716
BaO, SO_3	0·547	HO	2·048
NaO, SO_3	1·083	Org. Mat.	5·682
KO, SO_3	0·587		101·656

2. *Tooth of Titanotherium.*

a. Enamel.

Fibrous, with uneven fracture. Very tough. Hardness 4·7. Sp. Gr. 4·7 (at 20° C.) Color bluish gray. Opaque. Lustre—surface subvitreous, fibres pearly. Contains:

Mg	Ca	CaFl	Na	K	Si	S	P	C	H	Org. Mat.
0·219	51·872	0·099	1·288	0·239	0·611	1·011	39·348	3·165	0·626	2·538=101·016

with traces of oxyds of manganese and iron: which may be considered as

$3MgO, PO_5$	0·403	$3CaO, SiO_3$	1·727
$3CaO, PO_5$	83·835	CaFl	0·099
$2NaO, PO_5$	1·413	CaO	1·284
NaO, SO_3	1·437	HO	0·626
KO, SO_3	0·442	Org. Mat.	2·538
CaO, CO_2	7·212		101·016

3. *Tooth of Titanotherium.*

b. Dentine.

Compact. Fracture uneven, somewhat subconchoidal. Hardness 2·5. Sp. Gr. 2·935 (at 20° C.) Lustre dull. Color white, with gray spots and black streaks. Assumes a greenish tint when heated in presence of air, from the formation of manganic acid. Contains:

Mn	Fe	Mg	Ca	CaFl	Na	K	Si	S	P	C	Cl	H	Org. Mat.
traces	0·53	49·82	2·90	0·75	0·23	0·79	1·51	36·10	2·83	*trace*	2·10	2·66=100·22	

with traces of oxyds of manganese and iron: which may be considered as

$3MgO, PO_5$	0·98	CaO, CO_2	6·45
$3CaO, PO_5$	77·81	CaFl	2·90
CaO, SO_3	0·60	CaO	2·35
NaO, SO_3	1·71	HO	2·10
KO, SO_3	0·43	Org. Mat.	2·66
$3CaO, SiO_3$	2·23		100·22

4. *Tibia of Archæotherium.*

Compact; fracture uneven, somewhat splintery. Hardness 4. Sp. Gr. 2·826 (at 20° C.) Lustre pearly. Opaque. Color pink-

ish white. Assumes a greenish tint when heated in presence of air. Contains:

Mg	Ca	CaFl	Ba	Na	K	Si	S	P	C	H	Org. Mat.
1·140	47·052	5·086	1·131	1·572	0·276	0·259	2·200	32·957	2·270	1·971	4·086=100·000

with traces of chlorine, and oxyds of manganese and iron: which may be considered as

$3MgO, PO_5$	2·099	CaFl	5·086
$3CaO, PO_5$	88·582	CaO	6·517
$2NaO, PO_5$	1·079	$3CaO, SiO_3$	0·732
BaO, SO_3	1·723	HO	1·971
NaO, SO_3	2·443	Org. Mat.	4·086
KO, SO_3	0·510		
CaO, CO_2	5·172		100·000

With very few exceptions the analyses which have heretofore been made, show in the inorganic part but a slight difference between recent and fossil bones, which fact is sustained by the results of the present analyses. In the above investigations, a comparison with the analysis of a recent bone, shows that most of the organic matter has been destroyed, while the inorganic has undergone only slight changes. The difference in composition between these specimens and recent bones, can be satisfactorily accounted for by the effects of infiltration, by which new substances have been introduced, whilst a portion of the original constituents, being converted into soluble compounds, was washed out.

All the analyses present an excess of lime, which very probably exists in the form of a basic lime salt, as occurs in compounds well known in mineralogy.

The fluorid of calcium was determined as carefully as possible, to test the correctness of the opinion of some writers, who consider that fossil bones contain fluorid of calcium in a larger proportion than recent ones; but in no instance was so large a quantity found as in the analysis of fossil reptiles by Baumert,* where the fluorid of calcium in the Zeuglodon macrospondylus amounts to 9·54 per cent., and in the Hydrarchos to 16·67 per cent. By direct determination, Heintz† found the fluorid of calcium in two human bones to be 2·97 and 2·05 per cent.; the first of which corresponds exactly with the quantity found in the dentine of the Titanotherium. In the tibia of the Archæotherium a portion of the fluorid of calcium may have been introduced in a manner similar to that of the quartz and sulphate of baryta.

* Liebig und Kopp, Jahresbericht für 1851, p. 594.
† Pogg. Ann., vol. lxxvii, p. 267.

ART. III.—*A Consideration of some of the Phenomena and Laws of Sound, and their application in the Construction of Buildings designed especially for Musical Effect;* by J. B. UPHAM, M.D., Boston.

(Concluded from p. 363.)

WE have already pointed out how the resonance of a room, and the quality of the transmitted tone, are affected by the conformation and structure of its walls. Were these the only modifications of the original sound produced by the materials which circumscribe the limits of any apartment, the indications were plain; for, as we have seen, the same conditions that are necessary for a proper amount of resonance are those, also, required to maintain the strictest purity of intonation, so far as relates to the passage of sound from a denser to a rarer medium, and *vice versâ*.

But every sound shut in by the walls of a building, is subjected to the disturbing influences of reflection and reverberation. These are consequences which it is of the utmost importance to control or subdue, and, these also, are materially modified by the nature and conformation of the circumscribing limits. Unfortunately, the conditions of structure that would favorably affect the first mentioned desirable results, might unfavorably modify the latter. To explain:—so far as resonance and the perfection of the transmitted tone are concerned, the unity of structure required in the main body of the wall should not be disturbed at its surface; in other words, the internal face of such wall should be the solid surface of the substance used in its construction.* Now a wall of masonry, presenting a smooth and solid surface to the sound, will occasion an excess of the residuary portions which constitute direct reflection and reverberation; so that, however satisfactory be the effect of an isolated musical tone, the distinct utterance of a succession of sounds in moderate rapidity is rendered impossible. This is abundantly confirmed by observation and experiment. In a metallic chamber at Montrose, which had been constructed for the preparation of sulphuric acid, Dr. Reid observed that any sound produced in it continued in general for seven or eight seconds after the impulse which had given rise to it had ceased. In the interior of one of Barclay and Perkins' boilers,

* In illustration of this principle, witness the injurious effects of combining a variety of materials in the construction of musical instruments upon their free vibration, and the purity of tone imparted. Thus a flute, of which a part is ivory and a part wood, or a portion of which, as in the modern instruments is mostly the case, is sheathed with a lining of metal, loses in great degree its pure and mellow tone, though it acquires thereby, in its upper register, a certain piercing quality (brilliancy perhaps,) which gives it a greater prominence in the orchestra, and compensates, in the ears of many, for its losses in other respects.

sound produced in the same way, he states, continued for eight seconds. To these we may add our own observations in the obnoxious rooms at Girard College (before mentioned) which present an even and solid surface of stone internally. So also, in the case of the Musical Fund Hall in Philadelphia. This room is one hundred and twenty-one feet long, sixty broad and twenty-five and a half high to the centre of the arched ceiling, the depth of the arch, four feet four inches, included. Instead of being plastered upon a lathing, battened in the ordinary way, it has a smooth, solid finish upon the face of the wall. By experiments made in this apartment, when empty, we found a reverberation of peculiar intensity, which lasted four to four and a half seconds: on striking the wall, at various points, a sharp, clearly-defined echo was returned. Experiments in other rooms similarly situated, led to a like result.

How to provide fully in one and the same structure for results thus seemingly incompatible is a problem not easy to be solved. It seems to us, however, that walls of solid wood (fir or pine being preferred,) are fittest for the purpose, as containing, in the largest measure, the conditions required. Here alone, perhaps, can be found united the requisites for a free admission and conduction of the sonorous pulses with the conditions favoring also the suppression of excessive echo and reverberation. But, as we have before remarked, the expense of such a mode of building, together with its greater attendant risk in a large city, may prove an insurmountable objection to its use.

With a structure of masonry, means should be adopted to overcome, in some measure, the evils just mentioned (excessive reverberation, &c.); and we know of no way by which this can be better accomplished, with the least detriment in other respects, than by the plan of battening and wainscoting the walls, or of lathing and plastering upon them, after the ordinary methods employed in carpentry.* Thus we gain a *sound-surface* less impenetrable and unresisting than that of the solid walls, while the sonorous waves in their passage to the masonry beyond, find conditions as favorable to the free vibration of the whole structure as the nature of the case will admit. In this mode of finish, a space is left between the surfaces, which greatly assists absorption of the injurious excess of sound. A lining or sheathing merely, whether of wood or any other substance in *immediate contact with the wall*, not only excludes this provision but is objectionable, also, on the ground that it thus becomes more an integral part of the solid structure, destroying in greater degree that homo-

* We would be understood here to use the expressions *wainscoting* and *lathing and plastering*, in contra-distinction to a mere lining of wood or a layer of plaster upon the solid walls direct: (the profession will pardon us if we misuse their technicalities.)

geneity which it is our aim to preserve. It is analogous in its effects to the sheathing of a musical instrument.

One other question of practical utility comes up in this connection, viz.: as to the comparative superiority of thus battening and wainscoting such solid wall with wood, or of lathing and plastering it in the usual manner. Our preferences are in favor of the employment of wood for this purpose, substantially for reasons above stated.

As regards the subjects of VENTILATING, WARMING and LIGHTING, they have a broad range, and demand alike the attention of the architect, the philosopher and the philanthropist. Hitherto their importance, even in a sanatory point of view, has been too often overlooked or neglected. But aside from a due consideration for the health and comfort of a crowded audience, they are points which affect materially the acoustic properties of a room.

The conditions of the external atmosphere required for the greatest intensity, clearness and purity of tone, have been fully stated in a previous number. The effect of the different gases, and of a mixture of gases, vapors, or liquids of different chemical and mechanical natures, upon the communication of sound, has likewise been shown. From such facts and illustrations it is plain that whatever conduces to the purity of the contained air of a room, to its quiescent and equable state, uniformity of temperature and freedom from draughts and partial currents, adds to the truthful interpretation of sound therein. We are convinced the matter has not yet been sufficiently considered in this light, although the attention of the public has at various times been directed this way*. Dr. Bell, in his instructive address delivered before the Massachusetts Medical Society, in May, 1848, on the Practical Methods of Ventilating Buildings, thus recognizes the claims of his subject in this particular.

"Under the recent advances in this science, a true ventilation is designed, also, to comprehend the acoustic relations of the air, as well as its more palpable and material admixtures. At first thought, it may appear somewhat fastidious, and even unphilosophical, to regard merely unwelcome sounds, recognized by the ear alone, in the light of offensive impurities, or rather as disagreeable additions to the medium in which we live and intercommunicate, yet no explanation will be needed by a body of medical practitioners, residing, in part, in large towns and cities, for considering the means of obviating, or alleviating, the annoyances and injurious irritations of painful sounds, in the same category with the disagreeably offensive or actually malarious contaminations.

* * * * * * * *

"It is a gratifying coincidence, which will most fully develop itself, as the various modifications of the ventilating system are brought for-

* Vide Reports of the Parliamentary Committee in 1833 and 1835; and the able treatises on ventilation and warming by Tredgold, Reid and Wyman.

ward, that the improvements which have so fully satisfied the requirements of health and comfort, as respects respiration and purity to the senses, also meet the necessities of the ear. We shall see that under the complete arrangement for atmospheric supplies, secured in modern provisions, this rather more remote requirement is completely fulfilled, a necessity of the highest moment, as regards that somewhat extensive class of edifices, assembly rooms and halls, in which distinct and easy elocution, or the completest delivery and reception af musical sounds and literary compositions, are the principal desiderata.

"Under the aids of forced ventilation, or that on which an independent motive power is relied upon, all varieties of system require, as a condition of their full effect, the avoidance of any direct communication with the outside air, by the closure of all windows or openings which might admit foreign, or confuse designed vibrations. Hence, the purest effort of speech and music are transmitted to the audience, unmutilated and unmixed, and with the least labor and pain on the part of the vocal performer. The most refined enjoyments of the musical art, the most persuasive and overpowering effects of eloquence, and the full weight of instructive attempts, thus mingle their claims for consideration in this useful science, as well as the more immediate and pressing demands of body and mind, for exemption from disease, prolongation of days, and the highest intellectual and moral exercises."

It is much to be regretted that the orator did not, in this connection, suggest the details of a plan that would satisfy, in his own view, the merits of the cause he so eloquently pleads. We have not, however, space in the compass of this essay to discuss the science of ventilation, as at present understood, and its application to buildings of various kinds, but can only refer to such of its principles as we conceive are best adapted to our present purpose, leaving the details mostly for the imagination to supply.

Regarding the main object of a true ventilation to be the constant removal of the vitiated air and its immediate substitution by fresh supplies, the proposition now before us, is how most effectually to accomplish this end, with a just regard to the acoustic requirements which the uses of the structure demand. It is true we cannot, by any plan of artificial ventilation, fulfill all the conditions that would be desirable, for, as appears by the very nature of the case, there is required, in the room to be ventilated, a constant motion of the contaminated mass of air that its place may be filled with purer supplies from without, thus manifestly interfering with that state of absolute stillness and rest, which we have seen is essential to the perfect appreciation of sounds in the external world. But although such perfect excellence may not be obtained, we believe a nearer approximation to it can be made than exists in any hall for music of which we have knowledge.

It is a beautiful provision in nature, whereby the noxious products of respiration and combustion are carried upward by the

mass of heated air with which they are mingled. Hence is derived an important indication for an effectual system of artificial ventilation. And it seems to us especially necessary in the present case, that, whatever modification circumstances may require in other respects, the plan of introducing the pure air *from below* and providing for its discharge *above*, when vitiated, should be rigidly adhered to. Thus shall we most readily and quietly ensure the removal of all existing elements of acoustic disturbance, with the least danger of admitting new causes of a like tendency.

In a room, containing a crowded auditory, artificially lighted and warmed in the usual manner, the air becomes rapidly loaded with the products of respiration and combustion, and, too often, by the addition of coal gas from the furnace flues. The changes induced by these processes, in the surrounding medium, are abstraction of oxygen and the addition of carbonic acid gas and moisture, with inequality of temperature and the creation of noxious draughts at various points, all which tend to destroy that homogeneous and equable state of the air which we have found so desirable in its acoustic relations.* With a given audience the result of these changes upon sound is appreciable in a degree usually inversely proportioned to the cubic capacity of the room.† In its general provisions, the plan adopted by Dr. Reid for ventilating the temporary House of Commons seems admirably fitted to meet the exigencies of the case. His system was devised expressly to satisfy both the sanatory and acoustic requirements of that room. We take the following condensed account of it from the published address of Dr. Bell before quoted from.

"A series of openings through the wall into a court-yard, admits the fresh external air to the basement of the building. A suspended fibrous veil, 42 feet by 18, hangs before the external openings, the object of which is to separate the mechanical impurities, especially the flakes of soot, of which the London atmosphere is full, 200,000 visible portions having been arrested in a single evening.

"The air thus screened, is next passed into a *receiving chamber*, constituting about one-third of the basement. A partition divides this its whole length. At the middle of this wall, an opening permits the air to pass through an apparatus in which, by a thousand jets of water crossing each other in every direction, it is washed and moistened. It then

* It has been determined from experiments on animals and from its observed effects on men, that an atmosphere containing one per cent. of carbonic acid gas must be considered injurious to health, and as requiring immediate ventilation —*Dr. Wyman's Treatise*, p. 78.

W. T. Brande, Esq., states that he once examined the air in the upper part of Covent Garden Theatre, and found in it *three per cent.* of carbonic acid gas, produced by vitiation and imperfect ventilation. The same gentleman also declares that coal gas destroys (for breathing) thrice its bulk of oxygen and fifteen times that of air. —Vide *Report of the Committee on House of Commons Buildings appointed in* 1835.

† For the striking effects of mixed media in obscuring and stifling sound, the reader is referred to the illustrations given in the first part of this essay.

passes amongst iron tubes filled with hot water, by which its temperature is raised to any required degree. It now reaches a long chamber, parallel to the receiving chamber, from various parts of which apertures are left which allow the air to pass up into an *equalizing chamber* above, which extends under the whole Hall of Assembly. As the current passes up, it impinges against a flat board at each aperture, raised a short distance above, called a *disperser*, which throws the air somewhat horizontally, breaking the upward current.

"No less than 300,000 gimlet holes of a conical shape, with the smaller orifice upward, to prevent clogging by dirt, allow the air to escape into every part of the room above; and to make its diffusion more perfect, a hair cloth carpet, woven porously for the purpose, gives it an extreme and universal separation.

"The escape of vitiated air is provided for at the top of the room, where holes are left from one end to the other into a horizontal channel above, which is received into a descending flue passing to the ground and communicating with the lower extremity of a brick chimney, 110 feet in height. A fire grate, with a door of supply for fuel, is placed in the centre of this shaft, a portion of the air passing under it to supply the combustion, and the larger remainder at its sides. A valve or register, suspended in the main foul-air channel at the point above the ceiling where it turns to descend, regulates the rapidity of movement, and consequently, the quantity of air which is drawn through the house. It may be well to mention that the size of the room is 80 feet by 40, and 30 feet in height."*

Mr. John Sylvester, engineer, presented to the Parliamentary Committee a plan very similar in its provisions to that just described. He also proposed to admit fresh air to the House, first passing it above a cast iron apparatus heated by steam or hot water, through small inlets over the whole area of the floor, and provided for its exit by apertures in the ceiling. The combined area of the apertures he estimated at about 665 feet, through which he supposed the air of the house would be changed six times per hour. He estimated the entire capacity of the house at 200,000 cubic feet.†

In both these plans some important points are recognized, to which we would here direct attention as especially applicable to our present subject;—and, first, the *extreme diffusion* to which the air is subjected as it enters. In the ventilating and warming arrangements of our large halls for music and other public purposes, this most important principle is almost invariably transgressed. The hot air is admitted at two or three points, in large

* For a full description of these arrangements with diagrams, vide Reid's Illustrations of Ventilation, page 270 et seq.

An evidence of the remarkable uniformity of temperature maintained in the House of Commons, under this system, will be found in the tabular records in Dr. Wyman's Treatise, page 226.

† Report from the select Committee of the House of Commons, on ventilation, warming and transmission of sound, with the Minutes of evidence, 1835.

masses, through registers, not unfrequently placed along the central aisle of the room, and, not readily mixing with the surrounding atmosphere, rises in unbroken columns to the ceiling, whence it is at length diffused. By these shafts of heated air the sonorous vibrations are refracted, confused and obscured, the philosophical explanation of which we have already shown in the analogous effect upon light passing through strata of different densities and natures. The testimony of Dr. Reid in this particular is important. In his evidence before the Parliamentary Committee, he says:

"Another interruption to sound is the great body of air rising from the middle of the House, when the heating apparatus is in action; from this cause members cannot hear on the opposite sides, or the speaker persons at the bar."

One of the Committee also, when Reid mentioned this circumstance, stated that he had often noticed he could not hear a member opposite him distinctly, at particular times, unless he shifted his seat along the bench; and on examining the place referred to, it was found that he had moved to a position where the hot current no longer passed between him and the member speaking.* If not found practicable to give the air on its admittance the universal diffusion suggested in the plans just quoted, it can be made to enter after being previously tempered, beneath the benches all over the house, or through a continuous succession of apertures pierced in the floor, along the borders of the room, where an aisle might be left for that purpose. Better still, perhaps, a channel might be left in the walls close to the floor, and extending completely around the room, masked by perforated panel work, through which the attempered air would gradually flow into the apartment. It would be easy, in this way, to obtain an aggregate area of inlet apertures equal to that proposed in Mr. Sylvester's plan.

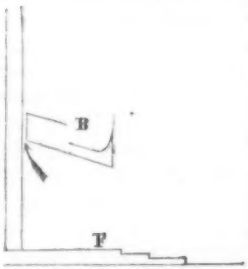
Not less important is it, also, to secure a *gentle and equable movement* of the entire mass of air through the apartment. With properly graduated inlets and outlets, arranged in the manner just described, together with the provision of a constant, controllable motive power (which is all important,) this result would naturally follow, were it not for other and foreign elements of disturbance.† Among the most serious of these is a predominance of

* In the old Tremont Temple at Boston, the air was introduced in this way, as is still the case at the Melodeon in that city and at the Musical Fund Hall in Philadelphia. At the Metropolitan (formerly Tripler) Hall in New York, the heated air is admitted through a series of registers placed along the sides of the room and escapes through a masked aperture in the centre of the ceiling: this, *so far as it goes*, is an improvement on the methods commonly employed amongst us, but the mode of lighting and the construction of the hall generally are faulty.

† Mr. Sylvester estimated that in his arrangements, the rate of the air's motion into the house would be half a foot per second, or about one-third of a mile per hour. At this rate, he says, a volume of air scarcely moves the most sensitive flame.

windows in the walls, inducing cold counter currents, which, in descending, bring down with them also the noxious vapors from above to mingle with the air of the room again.* This is an additional reason why windows in this situation should be as infrequent as possible; (we have before hinted at their injurious acoustic influence in other respects).

Again the various accessories and appendages to the main apartment are often a source of offence. Corridors, lobbies and entries, imperfectly warmed and ventilated, will give rise to sudden gusts and eddies of cold air, alike uncomfortable to the audience and injurious, in their general effect on sound. Much can be done here, as suggested by Dr. Bell, by duplicating the doors at the extremities of every passage or entry, so that the one in front is not opened till that in the rear has thrown itself to.† Underneath deep galleries the atmosphere is in a different state from that in the body of the room, and hence the difficulty often experienced in hearing distinctly in such situations. Moreover the heated air which there collects, is all the while pouring out in front, whence it rises in a tenuous wavy sheet to the roof, to the manifest discomfort of the occupants of the gallery itself. In such cases a narrow aperture left at intervals at the back of the projecting gallery, between it and the wall, as in the annexed figure, would obviate these evils and aid in preserving the unity and homogeneity of the air in the main body of the house.



B, Balcony.—F, Floor.

Care also should be taken in the arrangement of the ventilators in the ceiling, that too much sound do not escape with the vitiated air.

Dr. Wyman instances the case of a chapel, in which an opening for ventilation was made in the ceiling of an organ loft, directly over the organ. He states that when the chapel was crowded, and the current through the opening considerable, the organ became nearly inaudible to those upon the floor; the difficulty ceased immediately on closing the opening. Sound, we have seen, does not easily turn at right-angles; taking advantage of this fact, these outlets, as we have elsewhere explained, can be

* In confirmation of this effect of a surface of cold glass in disturbing the quiescent state of the air of a room, vide Wyman's Treatise, page 125.

† In fact, the cross draughts, supplies from sources and emissions of air at points not determined by the motive power, would be utterly inconsistent with any uniformly arranged plan. As Dr. Reid well remarks, the apartment to be ventilated on a scientific plan, is to be deemed and treated as a piece of philosophical apparatus, the results of the operation of which are to be interfered with by no fortuitous influences.—*Dr. Bell's Address*, p. 71.

contrived so that the vitiated air may readily enough escape, without a corresponding loss of sound.*

So intimately joined are the departments of ventilation and warming in their practical operation, that in treating of the former subject we have necessarily included, to some extent, the latter.

Connected with the warming of a building, such as we are now considering, there are two points of practical importance that are mainly to be considered, viz: First the propriety of uniting the mechanical appliances for heating and ventilation in one and the same plan; secondly, the nature of the apparatus to be employed, whether steam or hot water pipes, or the common furnace.

As regards the first of these questions, it appears to us preferable, considering all the objects to be accomplished, that the fresh air should be so attempered on its admission as to serve also to warm the apartment. In this way, while we gain an equally efficient ventilation, we can better secure a uniform temperature and avoid the existence of injurious currents, than if the warm and cold air were allowed to enter at different points. It would be well if the room were always warmed, previous to its use, to within a few degrees of the point required when the audience are present, inasmuch as the entering current will not immediately mix with air of a different temperature. To serve the purposes of a summer ventilation, or to allow the admission of cold air, if required, without its passing across the heating apparatus, a very simple arrangement only is necessary.

Concerning the second point, our preferences are decidedly in favor of the use of steam or the mild hot water apparatus, over every other system of which we have any knowledge. The question of its greater expense, we conceive, should not be placed beside its manifold advantages. As we have not room now for the discussion of these points, we refer the reader to the able treatises of Tredgold and Arnott for a full exposition of the superior virtues of the plan we would adopt; suffice it for us to say here, that in this way, only, do we believe an agreeable, salubrious and equable atmosphere in a large room, can be made certain.

But the methods to be employed in ventilating and warming a building intended for sound, are not alone in deserving a careful consideration; the manner of *lighting* the apartment also is not unimportant. Here the same principles are to be kept in view that have been previously stated. In the ordinary methods of artificial lighting, whether from gas, oil, wax or tallow, the air of a room is rapidly contaminated and admixed with the va-

* Saunders, in his treatise on theatres, recommends that these ventilators be closed during the performance of the piece and opened only between the acts. This however, is going to the opposite extreme.

rious products of combustion before enumerated. Moreover, by their injudicious position and arrangement, these lights have often a powerfully disturbing effect upon that state of quiescence in the air of an apartment which we have found so essential for the exact appreciation of sound. From this cause the foot-lights in front of the stage are inconvenient and objectionable, as the waving stream of hot air above them induces an amount of rarefaction, which impairs alike the sound and the distinctness of vision. A similar influence, as respects those seated behind them, has the row of gas burners so commonly affixed to gallery fronts and balconies. Chandeliers, pendent from the roof, however beautiful to the eye, are also offenses to the ear, which a rigid regard for acoustic excellence in a room would prohibit. Perhaps the extreme of consideration, in this respect, amounting almost to fastidiousness, is to be found in Dr. Reid's *exclusive system*, as he calls it, which he proposed for lighting the new Houses of Parliament. Here the illuminating source was entirely outside the space to be lighted, the light being diffused from pendants in the ceiling, or passing down through a cornice of glass which extended all round the room. Commenting on this plan, in the volume before alluded to, he remarks:

> "It will be obvious, that in some buildings, few lights would be more practically useful and agreeable than a series of gothic pendants with illuminated drops, appearing like stars diffused over the ceiling."

The system of lighting adopted in the Boston Music Hall is such as to avoid entirely the acoustic disturbances above mentioned, while, at the same time, it acts as the effectual motive power to the ventilating arrangements of the Hall. Here, as in the celebrated Philharmonic Hall at Liverpool, the gas jets are placed on the top of the cornice, at a height of fifty feet above the floor, and all the products of combustion escape immediately through the ventilating apertures above.

Having thus alluded, in a general way, to the main objects of ventilation, warming, and lighting, as applied to halls designed for acoustic effect, we leave the subject, for our space will not allow us to enter minutely into the description of a plan, that might comprehend all the virtues and avoid the evils we have named. We are sincere in the belief, however, that the condition of the common medium "in which we live and intercommunicate," and through which all sounds are conveyed to the ear, is a subject demanding the attention of the architect, who aims to construct a fitting abode for his kindred art, no less than the material shapes with which he would form and limit its bounds.

At this stage of our subject, there still remain a few points for consideration, which have a bearing upon the complete result.

It has been a mooted question among many, whether the surface of the walls and ceiling, in a room intended for sound, should be plain or broken at intervals by pilasters, panels, and ornaments of various kinds. The opinions of the architects before the Parliamentary Committee were divided in this particular; but the bulk of general evidence is decidedly in favor of the latter plan. Mr. J. Scott Russell advocates the use of pilasters against the walls of a room, to interrupt the oblique waves which fall along the surface, and constitute reverberation, on his theory.* Although our own views, as previously explained, differ, in some essential points from those adopted by Mr. Russell as to the nature of reverberation, they would seem even more strongly to require the provisions he has laid down for the amelioration of it; and, as we hinted when treating of the subject of harmonic relations in musical rooms, we would also argue the propriety of placing such pilasters, or other projections, at points corresponding with the nodal divisions of the wall. For analogous reasons we believe that coffers, cross-beams and deep mouldings in the ceiling are beneficial to sound. Practically, there is certainly much to favor these views. The best music halls in England have their walls treated in this manner. Says Robert Dale Owen on this point;

"It may be remarked that the ribs with deep mouldings intersecting each other on the Norman or Gothic vault, and thus paneling its surface, are not to be taken as mere ornamental features. In churches or halls designed for public speaking, as also in spacious school-rooms or the like, if the ceiling, whether flat or arched, be deeply panelled, the reverberation of the voice is checked, so as greatly to aid the speaker. Had the caissons in the dome over the Representatives' Hall in the Capitol at Washington been *actually sunk*, as in that over the Senate Chamber, instead of being merely *painted* on a smooth surface, it would undoubtedly have rendered that Chamber somewhat more suitable for public speaking."†

It was made an important feature in Dr. Reid's plan for a House of Commons, that the porous floor, while it allowed the diffusion to the attempered air, admitted for the purposes of ventilation, provided also a ready means of escape for the excess of

* It is a mistake to suppose that Mr. Russell has the merit of having first suggested the use of pilasters in this connection. They were recommended by Dr. Reid many years before, and on much the same grounds as those subsequently adopted by Mr. Russell.—*Vide Report on House of Commons Building*, 1835.

† At the National School the plaster of the ceiling was removed but the ceiling joists left, by which the excessive noise that formerly prevailed was greatly reduced. —*Reid's Illustrations.*

The ceiling of the chemical lecture-room in the East wing of the Smithsonian Institution is a Norman groined vault, intersected by ribs with deep mouldings. This room is found to be perfectly adapted for public speaking, and free from any unpleasant reverberation.—*Owen's Hints on Public Architecture.*

Vide also Inman and others in confirmation.

sound reflected from the ceiling. But it would seem that under ordinary circumstances, in a room constructed in accordance with the views above given, the clothing of the audience and the cushioned seats on the floor of the hall afforded sufficient material for the absorption of sound. And it is an easy matter to increase this effect to any required extent, by the judicious employment of upholstery and carpeting.

GALLERIES are generally regarded as prejudicial to sound. But they are almost necessary evils, when it is required to accomodate with comfort an auditory of three or four thousand persons, without extending unduly the area of the floor. What adds much to their injurious effect is the unreasonable depth with which they are ordinarily constructed, thus necessitating for their support the use of pillars, by which the pulses of sound are interrupted and broken: and when, as is mostly the case, these galleries have floors shelving back to the wall, with no provision for ventilation at that point, they become (as we have before suggested) vast receptacles for the impure air beneath. It seems to us, moreover, that a gallery, although it be so fashioned as to escape the evils just mentioned, is injurious in other respects, to the musical qualities of a room, when placed in immediate contact with its walls; for by impeding the free vibration of the latter, it must tend to destroy their resonance, acting, in this case, much in the same way as a damper placed upon a vibrating string, or a mute on the bridge of a violin.

The position of the ORCHESTRAL STAGE has become fixed by custom. There are those, however, who would have it removed to a point nearer the centre of the room, and for good philosophical reasons. Chladni and Herschell are among the advocates of this change, on the ground that the original impulse, being then more equally distant from all the walls, the hearer would suffer less from the effect of secondary or reflected sounds. On the same principle it might be urged also that the platform should be raised much higher from the floor than is usual, in order to lessen the appreciable amount of reflection from the roof. Considered wholly in reference to the truthful interpretation of the sound by the room itself, such is no doubt the correct doctrine. But in the first instance, we should lose the benefit of a solid reflecting surface behind, which serves to reinforce the original sound by a reflection so nearly synchronous with it as not to be appreciable by the ear; and in both, a considerable portion of the assembly must be deprived of a favorable view of the occupants of the stage. It is better, perhaps, to adopt a middle course between the two in this respect, aiming to satisfy, as nearly as may be, the acoustic requirements of the room with a just regard to the comfort and convenience of the audience.

A word here as to the disposition of the singers and instrumental performers themselves; and this is not a matter of indifference as regards musical effect. So far as position *can* do it, the various voices and instruments should be so grouped and arranged as to be recognized by the hearer, duly as parts of one integral whole; and for this most complete fusion and blending of all in one, there is required in every plan, some common point towards which the sounds may be delivered. The extremes should be within a moderate neighborhood of each other, and those in rear but little raised above the performers in front; in order thus to induce a greater sympathy of feeling and consequent co-operation of action, than when separated and individualized as they otherwise are.

Parabolic reflectors and recesses of other forms in rear of the orchestra can be productive only of injury to the general effect, for inasmuch as all upon the stage cannot be in the focus, the greater indistinctness and confusion only will follow from their use.

Again, *newness of structure* has its influence in the sounding qualities or intonation of a room. Here, as in many musical instruments, age seems in some measure to mellow down the asperities at first noticed. How this results it is perhaps not easy to explain. Can it be that from the constant vibration imparted by the sonorous impulses to the solid materials some change is gradually induced in the arrangement of their integral molecules, after the manner in which agitation sometimes affects the intimate structure of crystallizable bodies? But doubtless much is to be attributed to the natural effect of time in drying and consolidating and thoroughly assimilating the structure in all its various parts.

We here conclude our imperfect essay, ending as we began, with the regret that architects and scientific men have not honored with a more careful attention a subject so full of interest and so intimately connected with the welfare of an Art, now almost universally known and appreciated.

ART. IV.—*On the discovery of some Fossil Reptilian Remains, and a Land-shell in the interior of an erect fossil-tree in the Coal measures of Nova Scotia, with remarks on the Origin of Coal-fields, and the time required for their formation;* by Sir C. LYELL, F.R.S., V.P.G.S., &c.*

THE entire thickness of the carboniferous strata, exhibited in one uninterrupted section on the shores of the Bay of Fundy, in Nova Scotia, at a place called the South Joggins and its neighborhood, was ascertained by Mr. Logan, to be 14,570 feet. The

* From Proc. Royal Soc. of Great Britain, March 18, 1853.

middle part of this vast series of strata having a thickness of 1400 feet abounds in fossil forests of erect trees together with root-beds, and thin seams of coal. These coal-bearing strata were examined in detail by Mr. J. W. Dawson of Pictou, and Sir C. Lyell in September last (1852), and besides other results of their investigations they obtained satisfactory proof that several Sigillariæ standing in an upright position, or at right angles to the planes of stratification, were provided with Stigmariæ as roots. Such a relation between Sigillaria and Stigmaria had, it is true, been already established by Mr. Binney of Manchester, and had been suspected some years before on botanical grounds by M. Adolphe Brongniart; but as the fact was still doubted by some geologists both in Europe and America, it was thought desirable to dig out of the cliffs, and expose to view, several large trunks with their roots attached. These were observed to bifurcate several times, and to send out rootlets in all directions into the clays or ancient soils in which they had grown. Such soils or underclays with Stigmaria afford more conclusive evidence of ancient terrestrial surfaces than even erect trees, as the latter might be conceived to have been drifted and fixed like snags in a river's bed. In the strata 1400 feet thick above mentioned, root-bearing soils were observed at sixty-eight different levels; and like the seams of coal which usually cover them, they are at present the most destructible masses in the whole cliff, the sandstones and laminated shales being harder and more capable of resisting the action of the waves and the weather. Originally the reverse was doubtless true; for in the existing delta of the Mississippi the clays in which innumerable roots of swamp trees, such as the deciduous cypress, ramify in all directions, are seen to withstand far more effectually the excavating power of the river or of the sea at the base of the delta, than do beds of loose sand or layers of mud not supporting trees.

This fact may explain why seams of coal have so often escaped denudation, and have remained continuous over wide areas, since the roots, now turned to coal, which once traversed them would enable them to resist a current of water, whilst other members of the coal formation, when in their original and unconsolidated state consisting of sand and mud, would be readily removed.

The upright trees usually enclose in their interior pillars of sandstone, or shale, or both these substances alternating, and these do not correspond in the thickness of their layers, or in their organic remains, with the external strata, or those enveloping the trunks. It is clear therefore that the trees were reduced while yet standing to hollow cylinders of mere bark, (now changed to coal,) into which the leaves of ferns and other plants with fragments of stems and roots were drifted, together with mud and sand during river inundations. The stony contents of one of

these trees, nine feet high and twenty-two inches in diameter, on being examined by Messrs. Dawson and Lyell, yielded, besides numerous fossil plants, some bones and teeth which they believed were referable to a reptile; but not being competent to decide that osteological question they submitted the specimens to Dr. Jeffries Wyman of Harvard University in the United States. That eminent anatomist declared them to be allied in structure to certain perennibranchiate batrachians of the genera Menobranchus and Menopoma, species of which now inhabit the lakes and rivers of North America. This determination was soon afterwards confirmed by Professor Owen of London, who pointed out the resemblance of some of the associated flat and sculptured bones, with the cranial plates, seen in the skull of the Archegosaurus and Labyrinthodon.* In the same dark-colored rock, Dr. Wyman detected a series of nine vertebræ, which from their form and transverse processes he regards as dorsal, and believes them to have belonged to an adult individual of a much smaller species, about six inches long, whereas the jaws and bones before mentioned are those of a creature probably two and a half feet in length. The microscopic structure of these small vertebræ was found by Professor Quekett to exhibit the same marked reptilian characters as that of the larger bones.

The fossil remains in question were scattered about the interior of the trunk near its base among fragments of wood now converted into charcoal, which may have fallen in while the tree was rotting away, having been afterwards cemented together by mud and sand stained black by carbonaceous matter. Whether the reptile crept into the hollow tree while its top was still open to the air, or whether it was washed in with mud during a flood, or in whatever other manner it entered, must be matter of conjecture. Foot-prints of two reptiles of different sizes have been observed by Dr. Harding and Dr. Gesner on ripple-marked flags of the lower coal measures in Nova Scotia, evidently made by quadrupeds walking on the beach, or out of the water, just as the recent Menopoma is sometimes observed to do. Other reptilian foot-prints of much larger size had been previously noticed (as early as 1844) in the coal of Pennsylvania by Dr. King; and in Europe three or four instances of skeletons of the same class of animals have been obtained; but the present is the first example of any of their bones having been met with in America in rocks of higher antiquity than the Trias. It is hoped however that other instances will soon come to light, when the contents of upright trees, so abundant in Nova Scotia, have been systematically explored; for in such situations the probability of discovering ancient air-breathing creatures seems greater than in ordinary

* Professors Wyman and Owen have named the reptile Dendrerpeton Acadianum, Acadia being an old name for Nova Scotia.

subaqueous deposits. Nevertheless we must not indulge too sanguine expectations on this head, when we recollect that no fossil vertebrates of a higher grade than fishes, or any land-shells, have yet been met with in the Oolitic coal-field of the James River, near Richmond, Virginia, a coal-field which has been worked extensively for three-quarters of a century. The coal alluded to is bituminous, and as a fuel resembles the best of the ancient coal of Nova Scotia and Great Britain. The associated strata of sandstone and shale contain prostrate zamites and ferns, and erect calamites and equiseta, which last evidently remain in the position where they grew in mud and sand. Whether the age of these beds be Oolitic as Messrs. W. B. Rogers and Lyell have concluded, or Upper Triassic as some other geologists suspect, they still belong clearly to an epoch when saurians and other reptiles flourished abundantly in Europe; and they therefore prove that the preservation of ancient terrestrial surfaces even in secondary rocks does not imply, as we might have anticipated, conditions the most favorable to our finding therein creatures of a higher organization than fishes.

In breaking up the rock in which the reptilian bones were entombed, a small fossil body resembling a land shell of the genus Pupa, was detected. As such it was recognized by Dr. Gould of Boston, and afterwards by M. Deshayes of Paris, both of whom carefully examined its form and striation. When parts of the surface were subsequently magnified 250 diameters, by Professor Quekett of the College of Surgeons, they were seen to exhibit ridges and grooves undistinguishable from those belonging to the striation of living species of land-shells. The internal tissue also of the shell displayed, under the microscope, the same prismatic and tubular arrangements which characterize the shells of living mollusca. Sections also of the same showed what may be part of the columella and spiral whorls, somewhat broken and distorted by pressure and crystallized. The genus cannot be made out, as the mouth is wanting. If referable to a pupa or any allied genus it is the first example of a pulmoniferous mollusk hitherto detected in a primary or palæozoic rock.

Sir Charles next proceeded to explain his views as to the origin of coal-fields in general, observing that the force of the evidence in favor of their identity in character with the deposits of modern deltas, has increased, in proportion as they have been more closely studied. They usually display a vast thickness of stratified mud and fine sand without pebbles, and in them are seen countless stems, leaves, and roots of terrestrial plants, free for the most part from all intermixture of marine remains, circumstances which imply the persistency in the same region of a vast body of fresh water. This water is also charged like that of a great river with an inexhaustible supply of sediment, which had usually been

transported over alluvial plains to a considerable distance from the higher grounds, so that all coarser particles and gravel were left behind. On the whole the phenomena imply the drainage and denudation of a continent or large island, having within it one or more ranges of mountains. The partial intercalation of brackish water-beds at certain points is equally consistent with the theory of a delta, the lower parts of which are always exposed to be overflowed by the sea even where no oscillations of level are experienced.

The purity of the coal itself, or the absence in it of earthy particles and sand throughout areas of very great extent, is a fact which has naturally appeared very difficult to explain if we attribute each coal-seam to a vegetation growing in swamps, and not to the drifting of plants. It may be asked how during river inundations capable of sweeping away the leaves of ferns, and the stems and roots of Sigillariæ and other trees, could the waters fail to transport some fine mud into the swamps? One generation after another of tall trees grew with their roots in mud, and after they had fallen prostrate and had been turned into coal were covered with layers of mud (now turned to shale), and yet the coal itself has remained unsoiled throughout these various changes. The Lecturer thinks this enigma may be solved, by attending to what is now taking place in deltas. The dense growth of reeds and herbage which encompasses the margins of forest-covered swamps in the valley and delta of the Mississippi, is such that the fluviatile waters in passing through them, are filtered and made to clear themselves entirely before they reach the areas in which vegetable matter may accumulate for centuries, forming coal if the climate be favorable. There is no possibility of the least intermixture of earthy matter in such cases. Thus in the large submerged tract called the "Sunk Country," near New Madrid, forming part of the Western side of the valley of the Mississippi, erect trees have been standing ever since the year 1811–12, killed by the great earthquake of that date; Lacustrine and swamp plants have been growing there in the shallows, and several rivers have annually inundated the whole space, and yet have been unable to carry in any sediment within the outer boundaries of the morass.

In the ancient coal of the South Joggins in Nova Scotia, many of the underclays show a network of Stigmaria roots, of which some penetrate into or quite through older roots which belonged to the trees of a preceding generation. Where trunks are seen in an erect position buried in sandstone and shale, rooted Sigillariæ or Calamites are often observed at different heights in the enveloping strata, attesting the growth of plants at several successive levels, while the process of envelopment was going on. In other cases there are proofs of the submergence of a forest

under marine or brackish water, the base of the trunks of the submerged trees being covered with serpulæ or a species of spirorbis. Not unfrequently seams of coal are succeeded by beds of impure bituminous limestone, composed chiefly of compressed Modiolæ with scales and teeth of fish, these being evidently deposits of brackish or salt water origin.

The lecturer exhibited a joint of the stem of a fresh water reed (*Arundinaria macrosperma*) covered with barnacles, which he gathered at the extremity of the delta of the Mississippi or the Balize. He saw a cane-brake (as it is called in the country) of these tall reeds killed by salt water, and extending over several acres, the sea having advanced over a space where the discharge of fresh water had slackened for a season in one of the river's mouths. If such reeds when dead could still remain standing in the mud with barnacles attached to them, (these crustacea having been in their turn destroyed by a return of the river to the same spot,) still more easily may we conceive large and firmly rooted Sigillariæ to have continued erect for many years in the Carboniferous Period, when the sea happened to gain on any tract of submerged land.

Submergence under salt water may have been caused either by a local diminution in the discharge of a river in one of its many mouths, or more probably by subsidence, as in the case of the erect columns of the Temple of Serapis, near Naples, to which Serpulæ and other marine bodies are still found adhering.

Sir Charles next entered into some speculations respecting the probable volume of solid matter contained in the carboniferous formation of Nova Scotia. The data he said for such an estimate are as yet imperfect, but some advantage would be gained could we but make some slight approximation to the truth. The strata at the South Joggins are nearly three miles thick, and they are known to be also of enormous thickness in the district of the Albion Mines near Pictou, more than one hundred miles to the eastward. There appears therefore little danger of erring on the side of excess, if we take half that amount or 7500 feet as the average thickness of the whole of the coal measures. The area of the coal-field, including part of New Brunswick to the west, and Prince Edward's Island and the Magdalen Isles to the north, as well as the Cape Breton beds together with the connecting strata which must have been denuded or must still be concealed beneath the waters of the Gulf of St. Lawrence, may comprise about 36,000 square miles, which with the thickness of 7500 feet before assumed will give 7,527,168,000,000,000 cubic feet (or 51,136·4 cubic miles) of solid matter as the volume of the rocks. Such an array of figures conveys no distinct idea to the mind; but is interesting when we reflect that the Mississippi would take more than two million of years (2,033,000 years) to

convey to the Gulf of Mexico, an equal quantity of solid matter in the shape of sediment, assuming the average discharge of water, in the great river, to be as calculated by Mr. Forshey, 450,000 cubic feet per second, throughout the year, and the total quantity of mud to be as estimated by Mr. Riddell, 3,702,758,400 cubic feet in the year.*

We may, however, if we desire to reduce to a minimum the possible time required for such an operation, (assuming it to be one of fluviatile denudation and deposition,) select as our agent, a river flowing from a tropical country, such as the Ganges, in the basin of which the fall of rain is much heavier, and where nearly all comes down in a third part of the year, so that the river is more turbid than if it flowed in temperate latitudes. In reference to the Ganges, also, it may be well to mention, that its delta presents in one respect a striking parallel to the Nova Scotia Coal-field, since at Calcutta at the depth of eight or ten feet from the surface buried trees and roots have been found in digging tanks, indicating an ancient soil now underground; and in boring on the same site for an Artesian well to the depth of 481 feet, other signs of ancient forest-covered lands and peaty soils have been observed at several depths, even as far down as 300 feet and more below the level of the sea. As the strata pierced through contained fresh-water remains of recent species of plants and animals, they imply a subsidence, which has been going on contemporaneously with the accumulation of fluviatile mud.

Capt. Strachey of the Bengal Engineers has estimated that the Ganges must discharge 4½ times as much water into the Bay of Bengal, as the same river carries past Ghazipore, a place 500 miles above its mouth, where experiments were made on the volume of water and proportion of mud by the Rev. Mr. Everest. It is not till after it has passed Ghazipore, that the great river is joined by most of its larger tributaries. Taking the quantity of sediment at one-third less than that assigned by Mr. Everest for the Ghazipore average, the volume of solid matter conveyed to the Bay of Bengal would still amount to 20,000 millions of cubic feet annually. The Ganges therefore might accomplish in three hundred and seventy five thousand years the task which it would take the Mississippi, according to the data before laid down, upwards of two million years to achieve.

One inducement to call attention to such calculations is the hope of interesting engineers in making accurate measurement of the quantity of water and mud discharged by such rivers as the Ganges, Brahmapootra, Indus, and Mississippi, and to lead geologists to ascertain the number of cubic feet of solid matter, which ancient fluviatile formations, such as the coal-measures, with their associated marine strata, may contain. Sir Charles

* See Principles of Geology, 8th ed., p. 19.

anticipates that the chronological results, derived from such sources, will be in harmony with the conclusions to which botanical and zoological considerations alone might lead us, and that the lapse of years will be found to be so vast as to have an important bearing on our reasonings in every department of geological science.

A question may be raised, how far the coöperation of the sea in the deposition of the Carboniferous Series might accelerate the process above considered. The Lecturer conceives that the intervention of the sea would not afford such favorable conditions for the speedy accumulation of a large body of sediment within a limited area, as would be obtained by the hypothesis before stated, namely, that of a great river entering a bay in which the waves, currents, and tides of the ocean should exert only a moderate degree of denuding and dispersing power.

An eminent writer, when criticising, in 1830 Sir Charles Lyell's work on the adequacy of existing causes, was at pains to assure his readers, that while he questioned the soundness of the doctrine he by no means grudged any one the appropriation of as much as he pleased of that "least valuable of all things, past time." But Sir Charles believes, notwithstanding the admission so often made in the abstract of the indefinite extent of past time, that there is, practically speaking, a rooted and perhaps unconscious reluctance, on the part of most geologists, to follow out to their legitimate consequences the proofs, daily increasing in number, of this immensity of time. It would therefore be of no small moment could we obtain even an approach to some positive measure of the number of centuries which any great operation of nature such as the accumulation of a delta or fluviatile deposit of great magnitude may require, inasmuch as our conceptions of the energy of aqueous or igneous causes or of the powers of vitality in any given geological period must depend on the quantity of time assigned for their development.

Thus, for example, geologists will not deny that a vertical subsidence of three miles took place gradually at the South Joggins, during the carboniferous epoch, the lowest beds of the coal of Nova Scotia like the middle and uppermost consisting of shallow-water beds. If then this depression was brought about in the course of three hundred and seventy-five thousand years it did not exceed the rate of four feet in a century, resembling that now experienced in certain countries where, whether the movement be upward or downward, it is quite insensible to the inhabitants, and only known by scientific inquiry. If, on the other hand, it was brought about in two millions of years according to the other standard before alluded to, the rate would be only six inches in a century. But the same movement taking place in an upward direction would be sufficient to uplift a por-

tion of the earth's crust to the height of Mont Blanc or to a vertical elevation of three miles above the level of the sea. In like manner, if a large shoal be rising, or attempting to rise, in mid-ocean at the rate of six inches or even four feet in a hundred years, the waves may grind down to mud and sand and readily sweep away the rocks so upraised as fast as they come within the denuding action of the waves. A mass having a vertical thickness of three miles might thus be stripped off in the course of ages, and inferior rocks laid bare. So in regard to volcanic agency a certain quantity of lava is poured out annually upon the surface, or is injected into the earth's crust below the surface, and great metamorphic changes resulting from subterranean heat accompany the injection. Whether each of these effects be multiplied by fifty thousand, or by half a million or by two million of years, may entirely decide the question whether we shall or shall not be compelled to abandon the doctrine of paroxysmal violence in ancient as contrasted with modern times. Were we hastily to take for granted the paroxysmal intensity of the forces above alluded to, organic and inorganic, while the ordinary course of nature may of itself afford the requisite amount of aqueous, igneous, and vital force, (if multiplied by a sufficient number of centuries,) we might find ourselves embarrassed by the possession of twice as much mechanical force and vital energy as we require for the purposes of geological interpretation.

ART. V.—*Reëxamination of American Minerals:* PART II—*Chesterlite; Loxoclase; Danbury Feldspars; Haddam Albite; Greenwood Mica; Biotite; Margarodite; Chesterlite Talc; Rhodophyllite; Cummingtonite; Hydrous Anthophyllite; Monrolite; Ozarkite; Dysyntribite; Gibbsite; Emerald Nickel;* by J. LAWRENCE SMITH, M.D., Professor of Chemistry in the University of Virginia, and GEORGE J. BRUSH, Ph. B., Assistant to the Chemical Department.

IN this Second Part of the reëxamination of American minerals, we include many other doubtful species—the results concerning them being presented below under their respective heads. It may be well to mention that no mineral is analyzed, the authenticity of which is not placed beyond the shadow of a doubt; and in many instances specimens of the same mineral have been obtained from different cabinets, they having been originally collected by different persons. These labors have been very much facilitated by many of the proprietors of the finest collections in this county, and in addition to those mentioned in our last paper, we would acknowledge our obligations to Professors Dana and Silliman, Jr., Mr. Wm. S. Vaux of Philadelphia, Messrs. Jenkins

and Horton of Monroe, N. Y., Professor Hume of Charleston, Mr. Markoe of Washington, and Mr. Samuel W. Johnson of the Yale Laboratory.

In the analytical processes, with the exception of the alkali determinations, we have deviated but little from the methods usually employed. In separating magnesia from alumina and iron where one or both of these exist in some abundance, the iron and alumina are separated by ammonia with the previous addition of sal-ammoniac, but the precipitate is redissolved and reprecipitated three times before the separation is considered satisfactory; in addition to this, the oxyd of iron and alumina are finally tested to ensure the absence of magnesia.

A reëxamination of some of the minerals here noticed may appear useless, as they have been considered by many mineralogists for some time past as no longer distinct species. The special object of the analyses here given is to remove as far as possible any existing doubts connected with them. Moreover, in continuation of these researches, we propose to enter upon the reëxamination of a number of well established species, in order, by additional analyses of them, to extend our knowledge of American minerals.

11. *Chesterlite, identical with Orthoclase.*

This mineral occurs in implanted crystals on dolomite near East Bradford, Chester County, Pa. In physical characters it resembles orthoclase, but it has been considered triclinic, and Erni's analysis* gave soda as the alkali. The crystals occur frequently as twins, and are often very much distorted—in specimens we have examined the angle T on T′ varies from 121° to 127°—rendering it extremely difficult to determine the normal value of the angle; some of the measurements would however lead to the conclusion that it is monoclinic, since the angle of cleavage is by our measurements near 90°. So far as our opinion is concerned—based on both its chemical and physical character—we unhesitatingly pronounce it an orthoclase.

Two analyses gave:

	1.	2.
Silica,	64·76	65·17
Alumina,	17·60	17·70
Peroxyd of iron,	·50	·50
Lime,	·65	·56
Magnesia,	·30	·25
Potash,	14·18	13·86
Soda,	1·75	1·64
Ignition,	·65	·65
	100·39	100·33

These correspond to the composition of orthoclase, and chemically the mineral is identical with it; if it shall be proved that the

* Dana's Mineralogy, 3d edit., p. 678.

crystalline form is triclinic, it will be a potash albite and as such, an interesting species.

The specimens examined were received from Messrs. T. F. Seal and Wm. S. Vaux of Philadelphia.

12. *Loxoclase, identical with Orthoclase.*

The feldspar associated with pyroxene at Hammond, N. Y., has been named as a distinct species by Breithaupt.* Its crystalline form, hardness, specific gravity and other physical characters, are the same as orthoclase, and the reasons for forming a new species of it are based upon its cleavage and chemical constitution. The latter Plattner found to be,

Si	Al	Fe	Ca	Mg	Na	K	H
63·50	20·29	0·67	3·22	*trace*	8·76	3·03	1·23 = 100·70

We have examined two varieties of it. Analyses 1 and 2 are from specimens taken from a large crystal and were not perfectly pure, owing to intimate association with a lime pyroxene; analyses 3 and 4 are from a very pure crystal.

	1.	2.	3.	4.
Silica,	65·40	65·69	66·09	66·31
Alumina,	19·48	20·72	19·15	18·23
Peroxyd of iron,	1·25			0·67
Lime,	2·26	2·36	·94	1·09
Magnesia,	·20	·25	·21	·30
Potash,	2·76	2·36	4·35	4·35
Soda,	7·23	7·98	7·81	7·81
Ignition,	·76	·76	0·20	0·20
	99·34	100·12	98·75	98·96

It will be seen at a glance that the only difference between this mineral and orthoclase is the large amount of soda, and in analyses 1 and 2 a small amount of lime, this last, most of which is doubtless an impurity, alters somewhat the oxygen ratios.

No. 1	gives . . .	1 : 3·10 : 11
2	. . . .	1 : 3 : 10·60
3	. . .	1 : 2·90 : 11·08
4	. . .	1 : 2·74 : 10·83

This slight difference in the ratio (produced by the presence of a considerable amount of soda) is not uncommon in orthoclase. In that from Hohenhagen, Schnedermann found 4·15 potash and 7·53 soda; the flesh-red feldspar from Bathurst, Canada, gave Hunt 6·36 potash, 5·37 soda, and Gmelin found in the feldspar from Laurvig, 6·55 potash and 6·14 soda, and in that from Fredicksvärn, 7·03 potash and 7·08 soda. These numbers affect to some slight extent the oxygen ratio, but the correspondence of the minerals in physical characters denotes their identity with orthoclase. Moreover, the identity of loxoclase with orthoclase is

* Pogg. Ann., lxvii, 419.

made obvious when we take the ratio between the silica and alumina, which in the purer varieties (analyses 3 and 4) is as 4 : 1, and analysis 4 gives the ratio 12 : 3·04 : 1·11, or $\dot{R}\,\ddot{S}i + \dot{R}\,\ddot{S}i^3$.

The specimens examined were received from Professor Silliman, Jr., and Mr. Samuel W. Johnson.

13. *Danbury Feldspars;* 1. *Oligoclase;* 2. *Orthoclase.*

1. *Oligoclase.*—The feldspar in which the Danburite occurs has so strong a resemblance to the oligoclase from Sweden that we have been led to analyze it; the results of our examination prove its identity with that species. The analyses gave:

	1.	2.
Silica,	64·03	63·50
Alumina,	22·37	22·75
Peroxyd of iron,	*trace*	*trace*
Lime,	2·91	3·28
Magnesia,	*trace.*	*trace*
Soda,	10·06	9·37
Potash,	·60	·50
Ignition,	·30	·21
	100·27	99·61

These give the oxygen ratio 1 : 3 : 9 and the formula $\dot{R}\,\ddot{S}i + \ddot{A}l\,\ddot{S}i^2$, which are the ratio and formula for oligoclase.

2. *Orthoclase.*—There is also associated with Danburite a potash feldspar not unlike the soda feldspar just mentioned, in some cases it is so intimately associated with it as to require great care in selecting for analysis. So far as our observation extends, we have been able to identify the oligoclase by its occurrence in masses with a broad cleavage surface, and another less smooth, meeting at the angle 93°–94°; in orthoclase this angle is 90°, and most frequently it presents at this locality small cleavage faces and is sometimes of a granular structure.

The following analyses are of the latter variety, which doubtless contain a little oligoclase that it is impossible to separate.

	1.	2.
Silica,	63·80	63·95
Alumina,	18·90	19·05
Lime,	·80	·61
Magnesia,	·20	·20
Potash,	11·43	10·95
Soda,	3·86	3·69
Ignition,	·30	·50
	99·29	98·95

The specimens examined were taken from the locality by one of the authors.

14. *Haddam Albite, identical with Oligoclase.*

Associated with the iolite at Haddam, Conn., there occurs a glassy feldspar which has heretofore been called albite. Its com-

position is that of an oligoclase, as will be seen by the following analyses:

	1.	2.
Silica,	63·87	64·64
Alumina,	21·82	21·98
Lime,	2·14	2·17
Magnesia,	*trace*	*trace*
Soda,	10·18	9·80
Potash,	·50	·50
Ignition,	·29	·29
	98·80	99·38

The specimens examined were received from Prof. Dana.

We have examined the *moonstone feldspar*, from Mineral Hill, Delaware Co., Pa., which is also oligoclase.

15. *Greenwood Mica—Biotite.*

The chemical constitution of only a very few American biotites has been examined. In fact, von Kobell's* analysis of a mica from Monroe, N. Y., is the only one that has been published; unfortunately, even in regard to this, there is some doubt as to its locality, for biotite is found in more than one place near Monroe.

The specimens we have examined are from Greenwood Furnace, Monroe, N. Y.; the mineral occurs in large crystals of a dark olive green color, and the results of the analyses are such as to lead to the supposition that the specimens examined by von Kobell were from this locality. He obtained:

$\dot{S}i$	$\dot{A}l$	$\dot{F}e$	$\dot{M}g$	$\dot{K}$	HF	$\dot{T}i$	$\dot{H}$
40·00	16·16	7·50	21·54	10·83	0·53	0·20	3·00=99·76

The results of our analyses are:

	1.	2.
Silica,	39·88	39·51
Alumina,	14·99	15·11
Peroxyd of iron,	7·68	7·99
Magnesia,	23·69	23·40
Potash,	9·11	10·20
Soda,	1·12	
Water,	1·30	1·35
Fluorine,	·95	·95
Chlorine,	·44	·44
	99·16	98·95

These give the oxygen ratio:

	$\dot{R}$	$\ddot{R}$	$\ddot{S}i$
1.	11·31	9·31	20·72
2.	11·20	9·45	20·53

or very nearly 1 : 1 : 2, which corresponds to the formula

$$\dot{R}^3\,\ddot{S}i + \ddot{R}\,\ddot{S}i.$$

A small portion of the oxygen in the mineral is replaced by fluorine and chlorine.

The specimens examined were received from Messrs. Jenkins & Horton, of Monroe, N. Y.

* J. f. pr. Chem., xxxvi, 309, and Dana's Mineralogy, 3d edit., page 360.

16. *Biotite of Putnam Co., N. Y,*

In appearance this mineral resembles talc, having a wavy, lamellar structure, and a soapy feel. Its color is brownish green in mass, and pale yellowish green by transmitted light. Hardness 2–2·5. Sp. Gr. 2·80. The laminæ are entirely devoid of elasticity. It has been called pyrophyllite by some mineral collectors, but upon what grounds we are ignorant, as it does not possess the remarkable property of exfoliating and swelling up by heat, so peculiar to pyrophyllite. Analysis shows its composition to be identical with Biotite.

	1.	2.
Silica,	39·62	39·49
Alumina,	17·35	17·06
Peroxyd of iron,	5·40	5·21
Magnesia,	23·85	23·65
Potash,	8·95	——
Soda,	1·01	——
Water,	1·41	——
Fluorine,	1·20	——
Chlorine,	·27	——
	99·06	

$\dot{R}$ $\ddot{R}$ $\tilde{S}i$

Analysis 1 gives oxygen ratio 11·22 : 9·73 : 20·58, or 1 : 1 : 2, and the same formula as for the mineral last mentioned, $\dot{R}^3\,\tilde{S}i + \ddot{R}\,\tilde{S}i$.

The specimens examined were received from Mr. Silas R. Horton, of Craigville, New York.

17. *Margarodite.*

This mineral occurs at Lane's Mine, Monroe, Conn. It has been analyzed by W. H. Brewer,* but owing to some impurities in his specimens, he obtained an excess of silica.

Specimens very carefully selected, to avoid the fluor spar, and other minerals with which it is associated, gave:

	1.	2.
Silica,	46·50	45·70
Alumina,	33·91	33·76
Peroxyd of iron,	2·69	3·11
Magnesia,	·90	1·15
Potash,	7·32	7·49
Soda,	2·70	2·85
Water,	4·63	4·90
Fluorine,	·82	·82
Chlorine,	·31	·31
	99·78	100·09

These correspond to the analysis of margarodite from St. Etienne, in which Delesse found,

$\tilde{S}i$	$\dot{A}l$	$\dot{F}e$	$\dot{M}g$	$\dot{N}a$	$\dot{K}$	$\dot{H}$	Fl
46·23	33·08	3·48	2·10	1·45	8·87	4·12	*trace*=99·33

In a former paper we have mentioned the difficulty of obtaining a correct formula from the analyses of margarodite, owing to

* Dana's Mineralogy, 3d edit., p. 359.

slight differences in the protoxyds. The relation of the oxygen of the silica to that of peroxyds in most of the analyses, is as 3 : 2.

The specimens examined were received from Prof. Silliman, Jr.

18. *The Chesterlite Talc—a Mica.*

Associated with the Chesterlite, a micaceous mineral is found, which has been called talc. It occurs in implanted crystals, in minute tuft-like aggregations on dolomite, there is frequently an iron stain upon the surface, due to the decomposition of some of the minerals with which it is associated, the crystals are seldom over a line in diameter. Its chemical composition is that of a mica, but owing to the small amount examined it is impossible to say positively whether it be muscovite or margarodite, although from its association we are inclined to consider it muscovite.

Silica,	45·50
Alumina,	34·55
Peroxyd of iron,	*trace*
Lime,	2·31
Magnesia,	1·08
Potash,	8·10
Soda,	2·35
Water and carbonic acid,	5·40
	99·29

A large portion of the lime and magnesia is doubtless due to the dolomite with which it is associated.

The specimen was received from Mr. Thos. F. Seal.

19. *Rhodophyllite, identical with Rhodochrome.*

The violet colored mineral which occurs at Texas, Pa., and was circulated among mineralogists as "violet talc," has been analyzed by Dr. Genth,* of Philadelphia, who found for it a distinct composition, and gave it the above name. Its physical characters correspond with Rhodochrome and Kammererite, but as there had been no analysis published of the first, and as Dr. Genth's results did not agree with those obtained for Kammererite, he doubtless felt himself justified in considering it a new species. A short time after his results appeared, an analysis of rhodochrome was published by Hermann; its identity with those of rhodophyllite induced us to reëxamine the latter.

The results on two analyses are:

	1.	2.
Silica,	33·26	33·30
Alumina,	10·69	10·50
Sesquioxyd of chromium,	4·78	4·67
Peroxyd of iron,	1·96	1·60
Magnesia,	35·93	36·08
Soda and Potash,	·35	·35
Water,	12·64	13·25
	99·61	99·75

* Proc. Acad. Nat. Sci. Phil. vi, 122.

These will be seen to correspond with the analyses (1, 2) of Rhodophyllite by Dr. Genth, and the analysis of rhodochrome (3) and chrome chlorite (4), by Hermann.

	$\dot{S}i$	$\dot{A}l$	$\dot{F}e$	$\dot{C}r$	$\dot{N}i$	$\dot{M}g$	$\dot{C}a$	$\dot{L}i\,\dot{N}a$	$\dot{K}$	$\dot{H}$
1. Texas, Pa.	33·41		18·15		*trace*	35·86	*trace*	0·28	0·10	12·79
2. " "	32·98	11·11	1·43	6·85	*trace*	35·22	*trace*	0·28	0·10	13·12
3. L. Itkul,	34·64	10·50	2·00	5·50	——	35·47	——	——	——	12·03
4. Texas, Pa.	31·82	15·10	4·06	0·90	0·25	35·24	——	——	——	12·75

Our analyses give the formula, $4\dot{R}^6\,\ddot{S}i+\dot{R}^3\,\ddot{S}i+10\dot{H}$.

Dr. Genth gives the same formula minus one atom of water. The amount of oxyd of chromium varies in different specimens and to this is due the various shades of color. Dr. Genth informs us that he observed a like variation in the specimens he examined. The chrome-chlorite examined by Hermann was undoubtedly one of the light colored varieties.

Nickel as well as lime is found in some specimens, but both are impurities; the nickel is due to small particles of sulphuret of nickel which occurs at the same locality, and in many instances is disseminated through this mineral; in some specimens these impurities are not readily detected by the eye. In all probability the carbonate and silicates of nickel found on the Texas chrome iron proceed from the decomposition of this sulphuret.

Mr. T. H. Garrett* has recently given an analysis of this mineral. His results differ materially from those obtained above.

20. *Cummingtonite—a Hornblende.*

This mineral was described by Dewey,† and analyzed by Muir.‡ The latter obtained for its composition,

$\ddot{S}i$	$\dot{F}e$	$\dot{M}n$	$\dot{N}a$	$\dot{H}$
56·54	21·67	7·80	8·44	3·18=97·63

Authentic specimens for examination were procured from the Lederer collection in Yale College. Its structure is fibrous, resembling anthophyllite; lustre silky; color ash gray. It occurs in mica slate at Cummington, Mass.

Two analyses gave:

	1.	2.
Silica,	51·09	50·74
Alumina,	·95	·89
Protoxyd of iron,	32·07	33·14
Magnesia,	10·29	10·31
Manganese,	1·50	1·77
Lime,	*trace*	*trace*
Soda,	·75	·54
Potash,	*trace*	——
Water,	3·04	3·04
	99·69	100·43

* This Journal, May, 1853.
‡ Thomson's Min., i, 493.
† This Journal, [1] viii, 59.

These give the formula, $(\dot{F}e\,\dot{M}g)^4\,\ddot{S}i^3 = \dot{R}^3\,\ddot{S}i^2 + \dot{R}\,\ddot{S}i$.

	Atoms.	At. weight.	Per cent.	Oxygen ratio.
Silica,	3	1731·93	53·59	3
Protoxyd iron,	$2\frac{1}{2}$	1125·00	34·80	$1\frac{1}{2}$
Magnesia,	$1\frac{1}{2}$	375·00	11·61	

This is the chemical constitution of hornblende, and from its physical characters it was long since referred to this species.

21. *Hydrous Anthophyllite—an Asbestus.*

Thomson gave this name to an asbestiform mineral, which is found associated with chlorite on New York Island.* His analysis gives:

$\ddot{S}i$	$\dot{M}g$	$\dot{F}e$	$\dot{M}n$	$\dot{K}$	$\ddot{A}l$	$\dot{H}$
54·98	13·38	9·83	1·20	6·80	1·56	11·45=99·20

We have received undoubted specimens of this mineral from Messrs. Vaux, of Philadelphia, and Silas R. Horton, of New York. The asbestiform mineral, carefully freed from the chlorite and other impurities, gave on two analyses:

	1.	2.
Silica,	58·20	58·47
Magnesia,	28·96	29·71
Protoxyd iron,	8·46	9·06
Soda,	·88	·88
Potash,	*trace*	*trace*
Ignition,	2·26	2·26
Alumina,	*trace*	*trace*
	98·76	100·38

These correspond to the formula, $\dot{R}^4\,\ddot{S}i^3$ or $\dot{R}^3\,\ddot{S}i^2 + \dot{R}\,\ddot{S}i$.

	Atoms.	At. weight.	Per cent.	Oxygen ratio.
Silica,	3	1732·00	61·16	3
Magnesia,	$3\frac{1}{2}$	875·00	30·90	$1\frac{1}{2}$
Protoxyd iron,	$\frac{1}{2}$	225·00	7·94	

This is the formula given for the last mineral, and the composition is that of an asbestus or magnesian hornblende.

22. *Monrolite, identical with Kyanite.*

This mineral was described by Professor Silliman, Jr.† as a hydrous silicate of alumina resembling Wœrthite. Prof. Silliman, however, observes that the water varied in several specimens examined from 3·09 to 1·84 per cent.; subsequent examinations‡ made by one of us showed that the water in the pure mineral was not over one per cent.

In the analysis recently made, we find that the silica and alumina are the same as in kyanite, and that the high silica obtained by the analyst quoted, was undoubtedly owing to the impurity of the mineral, as a careful examination with the magnifier shows plates of quartz interlaced with almost every specimen. The re-

* Thomson's Mineralogy, i, 209.

† This Journal, [2] viii, 385.

‡ Dana's Mineralogy, 3d edit., p. 317.

sults of analysis on specimens carefully selected to avoid the quartz, gave

	1.		2.
Silica,	37·20		37·03
Alumina,	59·02		61·90
Peroxyd of iron,	2·08		
Ignition	1·03		·85
	99·33		99·78

These correspond to the formula $\dot{R}^3\ddot{S}i^2$.

23. *Ozarkite, an amorphous Thomsonite.*

This mineral was described by Professor Shepard as a new species.* It occurs in irregular veins and masses in Elæolite at Magnet Cove, Arkansas.

We are indebted to Mr. Markoe of Washington, for a large quantity of the Elæolite from which we were able to obtain the mineral in a pure state. Its color is white, structure granular to compact. Hardness 5; Sp. Gr. 2·24 (Shepard). Gelatinizes with hydrochloric acid.

Two analyses gave,

	1.		2.
Silica,	36·85		37·08
Alumina,	29·12		31·13
Peroxyd of iron,	1·55		
Lime,	13·95		13·97
Soda,	3·91		3·72
Water,	13·80		13·80
	99·48		99·70

This is the composition of Thomsonite, and the mineral is a massive variety of that species.

The analyses give the formula $\dot{R}\ddot{S}i+3\dot{A}l\ddot{S}i+7\dot{H}$ = Silica 37·8, alumina 31·5, lime 13·00, soda 4·80, water 12·90.

Special examination was made for phosphoric acid, but in the pure mineral none could be found, although in some impure specimens that one of us had previously examined,† it existed in the form of Apatite in considerable abundance, and the specimens examined were pronounced a mixture of apatite and a zeolite.

This mineral was first referred to the zeolites by Mr. J. D. Whitney,‡ who on a qualitative analysis found it to be a hydrous silicate of alumina and lime, with a little soda.

24. *Dysyntribite, a rock of indefinite composition.*

The substance to which the above name was given by Prof. Shepard,§ occurs in large masses in the Northern part of the State of New York. It is of a green color, sometimes mottled

* Am. Jour. Science, [2] ii.
† This Journal, [2] ix, 430.
‡ Jour. Bost. Soc. Nat. Hist., 1849, p. 42.
§ Rep. Amer. Assoc. Advan. Sci., vol. iv, 311.

with red. It resembles serpentine, but has a strongly argillaceous odor when moistened.

Having reason to suspect that the substance was not perfectly homogeneous—from our first analysis not agreeing with Prof. Shepard's,—various specimens were examined. The correctness of the supposition will be seen by comparing the following results.

	1.		2.	3.		4.	
Silica,	44·80	44·77	44·94	46·70	46·60	44·74	44·10
Alumina,	24·90	35·88	25·05	31·01	} 35·15	20·98	20·64
Iron,	3·01	2·52	3·33	3·69	}	4·27	4·03
Manganese,	·30	·30	*tr.*	*tr.*	*tr.*	*tr.*	
Lime,	·66	·52	8·44	*tr.*	*tr.*	12·90	12·34
Magnesia,	·42	·53	6·86	·50	·50	8·48	8·57
Potassa,	6·87	—	5·80	11·68	11·68	3·73	3·92
Soda,	3·60	—	*tr.*	*tr.*	—	*tr.*	—
Water,	5·38	4·72	6·11	5·30	5·30	4·86	6·30
	99·94		100·53	98·88	99·13	99·96	99·90

There is a remarkable agreement in the per-centages of silica. The mineral was found to lose about 2 per cent. of water by desiccation. Some specimens showed the presence of a small amount of phosphoric acid. Nos. 1 and 4 were received from Mr. S. W. Johnson, No. 2 from Mr. Silas R. Horton, and the exact locality of it is Diana, N. Y., No. 3 was received from Prof. Hume of Charleston, who obtained it from Prof. Shepard.

The original analysis by Prof. Shepard gave,

$\dot{S}i$	$\dot{A}l$	$\dot{F}e$	$\dot{H}$	$\dot{C}a$ $\dot{M}g$
47·68	41·50	5·48	4·83	*traces*

This substance bears a close relation to agalmatolite, which from the variable proportion of its constituents, cannot be considered a mineral but is a rock. Some of the specimens of dysyntribite give the composition of Pinite, but it is reasonable to suppose, that a mineral varying so much in its alumina, magnesia, lime and alkalies, may in different masses furnish a resemblance to a vast number of minerals.

25. *Gibbsite.*

Gibbsite was first described by Dr. Torrey * as hydrate of alumina. This composition, confirmed by Dewey and Thomson, was considered correct, until Hermann† announced the discovery of over 37 per cent. of phosphoric acid in it, and that the mineral was a hydrous phosphate of alumina. To satisfy all doubts in this matter, Prof. Silliman, Jr.,‡ examined it with direct reference to the occurrence of phosphoric acid, and in none of the specimens examined, could he find more than a trace. Subsequently Mr. Crossley,§ of Boston, analyzed it, and his results confirmed the previous analyses of American chemists; meanwhile Hermann‖

* N. Y. Med. and Phys. Journal, i, 68.
† J. f. pr. Chem., xl, 32.
‡ This Jour., [2] vii, 411.
§ This Jour., [2] ix, 408.
‖ J. f. pr. Chem., xlvii, 1.

reëxamined it, and found the phosphoric acid to vary in different specimens from 37·62 to 11·90 per cent.—showing that he had not obtained a homogeneous mineral.

Considerable pains have been taken to obtain a number of authentic specimens for examination, some of which are direct from the locality, and others from our own collection. The results show that the mineral is a hydrate of alumina, ($\dot{A}l\,\dot{H}^3$) with but a *trace* of phosphoric acid, and in some specimens not even a trace existed.

Two analyses gave,

	1.	2.
Alumina,	64·24	63·48
Peroxyd iron,	*trace*	*trace*
Water,	33·76	34·68
Silica,	1·33	1·09
Phosphoric acid,	·57	*trace*
Magnesia,	·10	·05
	100·00	99·30

The phosphoric acid was determined by molybdate of ammonia; the small amount of silica is due to the intimate mixture of the mineral with allophane. From the results of these examinations, we are confident that Mr. Hermann has not at any time analyzed pure Gibbsite.

26. *Emerald Nickel.*

We notice in the last edition of Phillip's Mineralogy, that Prof. Miller and Brooke place this species among the doubtful ones, without however giving any reasons for so doing. To ascertain if any good reason existed for this doubt, we have reänalyzed it, and find the same composition as given by Prof. Silliman, Jr.,* which was,

Oxyd Nickel.	Carbonic Acid.	Water.
58·81	11·69	29·49

We obtained,

		Oxygen
Oxyd of nickel,	56·82	12·10
Magnesia,	1·68	·67
Carbonic acid,	11·63	8·46
Water,	29·87	26·56

which gives the formula, $\dot{N}i^3\,\ddot{C}+6\dot{H}$.

	Atoms.	At weight.	Per cent.	Oxygen ratio.
Oxyd nickel,	3	1408	59·72	3
Carbonic acid,	1	275	11·66	2
Water,	6	675	28·62	6

We would prefer expressing its formula by an atom of carbonate of Nickel plus two atoms of the hydrated oxyd of nickel; this is rendered probable from the fact, that whenever it is attempted to form a carbonate of the protoxyd of nickel, by precipitating a protosalt with an alkaline carbonate, a carbonate is obtained,

* This Journal, [2] vi, 248.

containing a certain amount of the hydrated oxyd—for these reasons, we would express emerald nickel by $\dot{N}i\ddot{C}+2(\dot{N}iH_3)$.

It is without question a distinct species, and a most beautiful and interesting mineral, both from the richness of its color and its association with chromic iron.

Since completing our examinations of this mineral, we have observed an analysis of a mineral called emerald nickel, by Mr. T. H. Garrett.* The mineral examined was of a very impure description, and was supposed by the analyst to be a mixture of emerald nickel, meerschaum and augite; of course, it is impossible to furnish any correct idea of the composition of *pure* emerald nickel, from results on such impure specimens. This mineral is often associated more or less intimately with a nickel serpentine, or gymnite, but with an abundance of the mineral to select from, a hydrous carbonate of nickel can be obtained of a uniform composition; a quarter of an ounce of selected fragments sent by Mr. L. White Williams, furnished us with about one gramme of the pure mineral.

University of Virginia, May 6th, 1853.

ART. VI.—*New and ready method of determining the Alkalies in Minerals:* PART II—*Conversion of the Sulphates into Chlorids: Qualitative Determination of the mixed Alkalies: Separation of the Alkaline Chlorids from each other, with a more direct method of obtaining them from silicates not soluble in Acids;* by J. LAWRENCE SMITH, Professor of Chemistry in the University of Virginia.

Conversion of the Sulphates into Chlorids.

31. In continuation of the subject, the next point to be considered is the conversion of the sulphates of the alkalies into chlorids. The method ordinarily adopted to accomplish this change, is to precipitate the sulphuric acid by means of chlorid of baryum, care being taken to avoid the slightest excess of the latter. The annoyance attendant upon this exact precipitation, is familiar to all who may have had occasion to make the trial.

32. Instead of the chlorid of baryum, the acetate of lead is used; a solution of this salt is poured in excess upon the solution of sulphates, warming the latter slightly, the sulphate of lead readily separates, the whole can be immediately thrown on a filter and washed—a drop or two of the acetate of lead should be added to the filtrate, to insure there being an excess of the lead salt.

33. The filtrate is then warmed and sulphuretted hydrogen added—care must be taken to see that there is an excess of sul-

* This Journal, May, 1853.

phuretted hydrogen, a test most readily performed by means of a piece of lead paper. The liquid is thrown on a filter to separate the sulphuret of lead; the filtrate containing the alkalies as acetates, is evaporated, and when nearly dry, an excess of hydrochloric acid is added, and the whole evaporated to dryness over a water-bath, and finally heated to above 500°. A hot solution of the chlorid of lead can be used instead of the acetate, rendering the addition of hydrochloric acid unnecessary.

34. It needs but little experience to convince one of the superiority of this method, over that by the chlorid of baryum, for converting the sulphates into the chlorids, its principal recommendation being the indifference with which an excess of the lead salt can be added, to precipitate the sulphuric acid, and the subsequent facility with which that excess of lead can be got rid of. It may be well to state, that experiments were made to prove the perfect precipitation of the sulphuric acid from the sulphates of the alkalies by the salts of lead, and it is only after numerous comparative results, that it is now recommended.

To distinguish the Alkalies from each other when mixed.

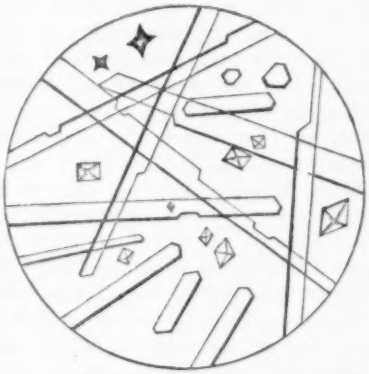
35. To distinguish potash, soda and lithia when mixed, is attended with more or less difficulty, according to the proportions in which they are mixed; of the three, potash is the most easily recognized, next in order is soda, and lastly lithia; the presence of which, mixed in small amount with proportionally large quantities of the other alkalies, it is almost impossible to decide on with any accuracy, without direct separation.

36. In the analysis of many minerals, the characters of which lead to the supposition of the presence of the alkalies, it is useless to precede the quantitative determination by one of a qualitative character, especially as the steps to be followed to separate the alkalies are the same in both cases, and to proceed in this way, is economy of time. From my own experience concerning the constitution of the silicates, there are doubtless but a very few of them without an appreciable quantity of alkalies in their constitution; and an easy method to examine with certainty the composition of such small quantities of alkaline chlorids must add to our analytical knowledge. With a little experience, the method about to be described will be found very available.

37. To ascertain the nature of the alkalies present in the chlorids before proceeding to separate them, we abstract a quantity so small as not sensibly to affect the weight of the mass. The smallest piece of the dried mass that need not exceed $\frac{1}{30}$ of an inch in diameter, is placed on a slip of glass, and to it is added a drop of a watery solution of *very pure* chlorid of platinum,* not too concentrated, and the plate gently warmed; if potash be present

* The alcoholic solution does not give perfect results and should not be used.

a yellow deposit soon takes place, which by the microscope will be seen to consist of octahedral crystals of the double chlorid of potash and platinum: the evaporation should be continued very gently with a heat not exceeding 120° to 130° until the liquid begins to dry on the edge; if this be now examined under the microscope, and soda be present, beautiful needle-shaped crystals will be seen, both formed and forming, with an oblique angle of termination, the crystals frequently having reëntering angles as represented in the figure. The border of liquid on the glass is the place to observe these crystals, and that, while the process of drying is going on. When the amount of soda is very small, it is best to allow the solution on the glass to dry in the slowest possible manner. Should the quantity of soda be still smaller or the nature of the crystals doubtful, resort may be had to polarized light, when the prismatic crystals of chlorid of platinum and sodium will be at once rendered visible by their beautiful colors, as they possess polarizing properties, whereas the crystals of chlorid of platinum and potassium, besides differing in form, do not polarize light.



38. This method of detecting a small quantity of soda in the presence of potash, I have employed since June, 1850, while engaged in the examination of the collection of urinary calculi belonging to the Dupeytren museum at Paris; at that time, it was employed daily in the laboratory of Messrs. Wurtz and Verdeil; the special reason for devising it was to examine the nature of the trace of alkali almost invariably found in the uric acid calculi after combustion.

39. The reason for making special reference to the date of the original employment of this method, is to claim priority in its use, as Mr. Andrews announces it in a late number of the Chemical Gazette as a new method. Were not the method so well known and so constantly employed in the laboratory of Wurtz and Verdeil at the period above mentioned, I should not now set up any reclamation in the matter.

40. The amount of soda that can thus be detected, is exceedingly small, as the liquid can be concentrated to the very smallest bulk. When the amount of potash is proportionally large compared with that of the soda, it is better to put the chlorid of platinum in a drop of the solution of the alkaline chlorids placed

in a watch glass, allow the potash salt to settle, take a little of the clear liquid, place it on a slip of glass, evaporate slowly, and examine in the way already mentioned. We should avoid the use of alcohol as a solvent for the salts employed.

41. For the full appreciation of this method it requires some experience, and on first trials the extreme results will not be readily obtained; too much care cannot be taken with reference to the evaporation, sometimes if the evaporation be a little too speedy, no indication of the presence of soda will be evinced—so, in all doubtful instances, the glass should be laid aside for an hour or two, when the excess of the chlorid of platinum will attract moisture from the air and afford an opportunity for the chlorid of platinum and soda to crystallize regularly. For the most perfect success in very minute quantities of soda, too great an excess of chlorid of platinum should be avoided. Those engaged in mineral analysis, who will employ this means of detecting the presence of the alkali, will find it of great assistance in facilitating their labors, especially when directed to very minute accuracy in their results, for I have reason to believe it rare to find in minerals any one of the alkalies perfectly free from one of the others.

42. When the chlorid of lithium is present, it interferes materially with this method of detecting small amounts of soda, for owing to its very deliquescent nature, it abstracts moisture from the air, and dissolves the double chlorid of sodium and platinum, or prevents altogether its formation into recognizable crystals. These investigations have added nothing to what is already known concerning the detection of lithia mixed with soda and potash; the plan invariably adopted, is to treat the mixed chlorids with a solution of alcohol and ether, and examine the part dissolved, by the blowpipe; details as to the manner of using the alcohol and ether solution are given under the next head.

Separation of the Alkalies from each other.

43. Under this head I have nothing to add to what is already known on the subject: it may be well, however, to mention the manner in which Rammelsburg's method of separating lithia has been employed, as it has not yet been fairly tested in this country. His method, it is well known, is based on the solubility of the chlorid of lithium in a mixture of equal parts of absolute alcohol and ether, neither of the other chlorids being dissolved by this menstruum. A number of experiments were made on known quantities of the alkalies, and the results of some of them are as follows:

a. 500 milligrm. chlorid of potassium treated with the mixture of ether and alcohol, ten grammes of the latter being used, yielded only $\frac{3}{10}$ of a milligramme to the liquid.

b. 500 milligrm. of chlorid of sodium treated in the same way yielded ½ milligramme to the liquid.

c. A mixture of chlorids of potassium, sodium and lithium, in which the latter constituted 2 per cent. of the mass, was acted on by the ether and alcohol, filtered and evaporated to dryness; the residue was equal to 2·53 per cent. The quantity used, was Cl K and Cl Na each 200 milligrm., Cl Li ·8 milligrams.

d. A similar mixture containing 18·10 per cent. of chlorid of lithium, furnished a residue of 17·65 per cent.

e. A similar mixture containing 67·20 per cent. chlorid of lithium, gave a residue of 68·40

44. By these results it may be seen that this method of separating lithia from the other alkalies may be perfectly relied on. It only remains to detail the precautions to be taken in order to ensure accurate results.

45. The solution of alcohol and ether must be made of absolute alcohol mixed with its volume of pure ether. The chlorids must be dried thoroughly at 212° or a little above; if they have at any time been heated much higher, a drop or two of hydrochloric acid must be added to the chlorids, that are subsequently dried at the temperature just mentioned. The desiccation is best carried on in a small sized capsule. To the dry mass, a small quantity of the mixture of alcohol and ether is added, and stirred with a small glass rod, the chlorids soon disintegrate; the capsule and its contents are placed on a glass plate, and covered with a small bell glass; (a common tumbler answer the purpose very well, especially if the edge be ground,) this is left to digest for twenty-four hours, and then thrown on a filter and washed with the *alcohol ether* solution, the chlorids of sodium and potassium remain on the filter. These last can be dissolved off the filter by means of water, and separated in the ordinary way.

46. The alcohol-ether solution of chlorid of lithium is evaporated to dryness, converted into sulphate and weighed. The results thus obtained far exceed in accuracy those from any other method for separating lithia. The indirect method, by ascertaining the quantity of sulphuric acid contained in the mixed sulphates, is the next best, but like all indirect methods of analysis, should never be employed except when it is absolutely necessary.

47. When the alkalies are presented in the form of chlorids before their quantity has been estimated in some other form, it is best to proceed first to the separation of lithia, afterwards weigh the chlorids not dissolved by the *alcohol-ether*, and lastly, separate the potash chlorid from the soda chlorid, if both be present, by means of the bichlorid of platinum. Experiments were made with a mixture of alcohol and chloroform, the results

of which were not as satisfactory as those afforded by the alcohol-ether.

Substitution of Chlorid of Ammonium for Fluorid of Calcium, to mix with Carbonate of lime to decompose the silicates.

48. It was mentioned in the previous paper on this subject how carbonate of lime could be rendered as powerful in its decomposing agency on the silicates as caustic potash, the effect being due to the use of some flux, fluorid and chlorid of calcium being used for that purpose. I have since tested more carefully the merits of the chlorid of calcium, and for various reasons prefer it to the exclusion of the fluorid. In the first place it introduces chlorine instead of fluorine into the analysis, and secondly, the fusion is more easily detached from the crucible, and dissolved by hydrochloric acid.

49. The manner of introducing the chlorid of calcium into the mixture of mineral and carbonate of lime was a point of some little importance, as from the deliquescent nature of that compound it was inconvenient to weigh and mix it with the carbonate of lime and mineral; these difficulties are obviated by employing *chlorid of ammonium* to form indirectly the chlorid of calcium.

50. The process which appears to leave hardly any thing to desire, is to take *one part of the finely pulverized mineral, five to six of carbonate of lime, and one-half to three-fourths of chlorid of ammonium*,* mix them intimately in a glazed mortar, introduce the mixture in a platinum crucible, heat to bright redness in a furnace† from thirty to forty minutes.

51. There is no silicate which after having undergone this process, is not easily dissolved by hydrochloric acid. For the action of the lime to have been complete, it is not necessary that the mass should have settled down in perfect fusion. The contents of the crucible are dissolved, and the analysis continued as pointed out in 19, 20, 21, &c.

52. This method insures the obtaining of every particle of the alkalies in the mineral examined, requiring no more precaution than any good analyst is expected to take in the simplest of his processes, and not the least of the advantages, is the ready method of separating all the other ingredients and the small accumulation of water arising from the little washing necessary.

* The chlorid of ammonium is best obtained in a pulverulent condition, by dissolving some of the salt in hot water, and evaporating rapidly; the greater portion of the chlorid of ammonium will deposit itself in a pulverulent condition, the water is poured off, and the salt thrown on bibulous paper, allowed to dry; the final desiccation being carried on in a water-bath, or in any other way with a corresponding temperature.

† An ordinary portable furnace with a conical sheet-iron cap of from two to three feet high, answer the purpose perfectly well, all the requisite heat being afforded by it.

A more speedy method of separating the Alkalies directly from the lime fusion for both qualitative and quantitative determination.

53. As soon as the fusion with carbonate of lime and sal-ammoniac, gave evidence of the mineral being so thoroughly attacked, the question naturally arose as to the condition the alkalies were in after the fusion, and the possibility of dissolving them out by the agency of water alone, at least for the purpose of qualitative determination. Experiments directed to this object soon made it evident that the alkalies might be obtained from any silicate, without resorting to the use of acid as a solvent for the fusion.

54. The mass as it comes from the crucible, is placed in a capsule with water, and then heated in a sand-bath or over a lamp for two or three hours, renewing the water from time to time as it evaporates. The mass disintegrates very shortly after being placed in the water. The contents of the capsule are next thrown on a filter, and the water passes through containing the chlorid of the alkalies, a little chlorid of calcium and caustic lime, all else that the mineral may have contained remains on the filter, except baryta and strontia if they be present in the mineral, but as these oxyds are of rare occurrence in silicates, no allusion will be had to them here.

55. To the filtrate add carbonate of ammonia and boil for some time, when all the lime will be precipitated as carbonate, add a few drops of a solution of carbonate of ammonia to the hot solution to be sure that all the lime is precipitated, should this be the case, filter—the filtrate will contain the chlorids of the alkalies and chlorid of ammonium; it is evaporated to dryness over a water-bath in a small platinum capsule; the capsule is carefully heated to expel the sal-ammoniac, and finally warmed up to 7 or 800° F., it is then weighted with its contents, and the chlorids if mixed, separated in the way mentioned (45 and 46). The amount of sal-ammoniac to be expelled is quite small, not equalling the weight of mineral originally employed.

56. Nothing in analysis can be simpler or more speedy than this process. Its constant accuracy still lacked some little to render it perfect, as usually an amount of alkali remains behind, represented by from $\frac{2}{10}$ to one per cent. of the mineral used, certainly a small amount, but still too much to be omitted in an accurate analysis. This also must be arrived at, and it can be accomplished in the following manner.

57. After the fused mass has been treated with water filtered and washed as in (54), the filter and its contents are dried, the latter are detached from the filter, and rubbed up in a glazed mortar with an amount of sal-ammoniac equal to one-half the weight of the mineral, and reheated in a platinum crucible exactly as in the first instance, treated with water, thrown on a filter and washed, the filtrate added to that from the first fusion, the whole treated with carbonate of ammonia, and completed as in (55).

58. This second fusion complicates the method but little, as the residue on the filter readily dries in a water-bath into a powder that is easily detached from the filter, and the small portion adhering to the latter may be disregarded, as the alkalies remaining rarely exceed more than $\frac{1}{500}$ of the whole mass, and in most instances not more than $\frac{1}{1000}$. In many analyses made, one fusion sufficed for the entire extraction of the alkalies, but as a few tenths would occasionally remain behind, we preferred the additional fusion to get at that small quantity, and to entitle it to rank as a method by which all but the merest trace of the alkalies could be extracted from the insoluble silicates.

59. The proportion of sal-ammoniac added to the carbonate of lime as here recommended, is arrived at after numerous experiments. By increasing the sal-ammoniac, and thereby augmenting the amount of chlorid of calcium formed, the mass fuses more thoroughly, but the water does not disintegate it as completely as when the ammoniacal salt is less; also the accumulation of this latter at the end of the process is less, an object not to be disregarded. The advantage of thus estimating the alkalies in insoluble silicates is obvious;—the long routine of separating silica, alumina, lime, &c., is done away with—the accumulation of chlorid of ammonium is very trifling,—and lastly, the alkalies are obtained directly in the form of chlorids. The method will vie in accuracy with any other, including the one already mentioned in the first part of this paper, and at the same time it is unequalled in simplicity, speed of execution, and constancy of results.

60. In examining for alkalies qualitatively, one fusion will of course be all that is necessary, and the action of the water need not be continued more than thirty minutes before filtering. This method will not answer when boracic acid is present in the silicate; the manner of proceeding in such a case will be mentioned in a future paper on the determination of Boracic acid in minerals.

61. There is nothing new in the attempt to dissolve out the alkalies by water, from a silicate that had been heated with lime. M. Fuchs used the method for procuring lithia from lepidolite, but of course his efforts were entirely directed to procuring the lithia from the mineral, and not to estimating its quantity, as the method he followed could not have furnished such results. I have also lately learned that Mr. A. A. Hayes of Boston, proposed and employed a mixture of chlorid of calcium and caustic lime, to decompose alkaline silicates, heating over a lamp and subsequently treating the mass with water to extract the alkalies or chlorids; as little has been heard of this process, I presume the author found it defective. If we are correctly informed, the proportions used were three parts of chlorid of calcium and one of caustic lime, experience proves, that however readily such a mixture may reduce the feldspars, it fails when tried on kyanite, zircon, micas and other silicates difficult of decomposition. This

arises from the fact that the chlorid of calcium has but little decomposing effect on the silicates, its action being simply that of a menstruum in which the lime can act conveniently on the mineral.

62. The use of lime or its carbonate mixed with chlorid of calcium or chlorid of ammonium, for the purpose of effecting the decompositions alluded to, would be considered by me of questionable utility if the mixture were not so proportioned, and employed as to decompose the most difficult silicates if necessary; for unless this be done, we can at no time be certain that the decomposition is complete. As a general rule for decomposing silicates by lime or soda, it is far better to use a charcoal fire than the flame of a lamp, as it is better to heat too high than not to heat sufficiently the mineral to be acted on.

Complete analysis of an insoluble silicate on one portion of the Mineral.

63. The effort to accomplish an analysis of this description deserves no encouragement, from the almost invariable inaccuracy attending the results. If we have a given quantity of any one of the silicates alluded to, requiring analysis, we had better subdivide it, however small the entire quantity may be, ascertain one set of ingredients by the soda, and the other by the lime fusion; for the results thus obtained, may be relied on as more accurate than those furnished by an analysis of the whole quantity, through the agency of baryta or hydrofluoric acid.

64. Should it be desired to undertake the analysis on a single portion, I would recommend the silicate to be attacked with *carbonate of baryta mixed with the chlorid*—three to four parts of carbonate and two of chlorid: this mixture can be made to decompose all silicates at a much lower temperature, than when the carbonate alone is used, but its action is not near so powerful as the carbonate of lime and sal-ammoniac.

65. This terminates an account of my labors in the determination of the alkalies in insoluble silicates, the conclusions have been arrived at from more than two years experience, and over a hundred alkali determinations by myself and others, made on minerals of the most varied composition. In my laboratory, an accurate alkali determination is one of the most simple and speedy analytical processes now conducted, and the presence of magnesia in no degree complicates the result. A little experience will no doubt bring others to the same conclusions. Many singular decompositions of salts have been noticed in the course of these researches, but as they do not bear directly on the object of this article, they will be made known on another occasion.

Many analytical processes mentioned in this article can be applied when operating on soluble silicates.

Laboratory of the University of Virginia, May 10th, 1853.

ART. VII.—*On a method of constructing an Observatory on a Dwelling-house ;** by Mr. JOHN CAMPBELL.

THE idea of placing a telescope sufficiently large to require a revolving dome upon the top of a dwelling-house is so novel, that those who are interested in such subjects will doubtless wonder how a dome could be constructed in a situation of the kind, when as in this case, such an addition was not contemplated at the time the house was erected. An account of the manner in which the thing has been accomplished, may therefore be acceptable to some persons, and perhaps be the means of inducing others imbued with a love of the sublimest of the physical sciences, to make a similar experiment.

The house is situated in 16th Street, near the 5th Avenue. It is thirty feet wide, eighty feet deep, and four stories high. Like most modern houses it is constructed with an under cellar, the foundation walls are therefore about fifteen feet below the level of the street.

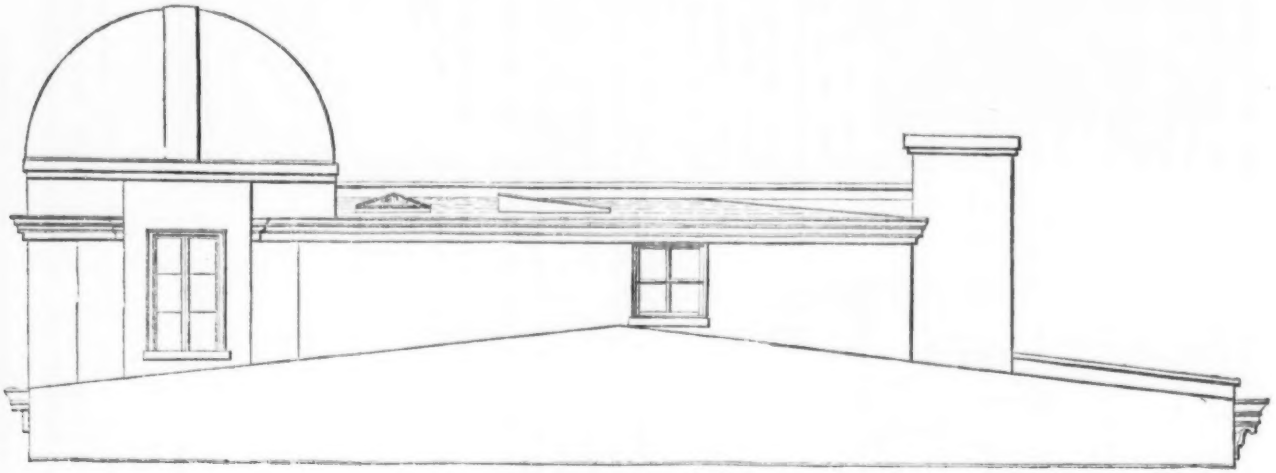
The hall is ten feet wide, and the partition wall which separates this part of the house from the rooms, is of brick, and extends to the roof. This, and the adjoining gable wall were raised, so as to make another story over that part of the house, and a room was thus obtained ten feet wide, and thirty-five feet long. Twelve feet at one end is appropriated for the dome and telescope. Fig. 1. The remainder makes a convenient appendage for books, apparatus and reading. The Observatory or equatorial room, is furred off, so as to make an octagon of twelve feet span, to effect which, it was necessary to project a little over the partition wall, on the roof of the main building, which will be easily understood by reference to the plan, fig. 2. See p. 64.

The octagonal shape is preserved to the height of five feet, it then assumes that of a circle to correspond with and support the wooden curb, which constitutes the bed plate of the dome, and upon which that superstructure is made to revolve, at the height of seventy-feet from the ground. Three stout beams rest upon the walls across the centre of the octagon, making a base or support for the pedestal of the telescope. The floor is raised three feet above that of the reading-room, care being taken not to permit any thing to rest upon, or touch the three beams which sustain the pedestal.

A door opens into the reading-room, and another upon a platform, over the roof of the other part of the house. Opposite to these doors are windows for light and air. See ground plan, fig. 2.

* The above description by Mr. Campbell of a convenient method of adding an astronomical observatory to a dwelling-house in a city, is deserving of attention from amateurs in the science. The author states in a letter to the Editors, that he will send a copy of his paper on the subject to any one who may be interested, and shall be happy to see them in New York and give any further information.—EDS.

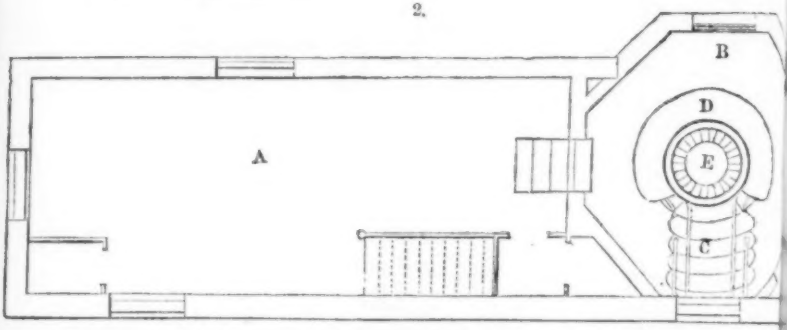
1.



Appearance of the Dome from the outside.

It is hardly necessary to say that the foregoing arrangements are altogether local, and on any other site would be varied according to circumstances.

2.



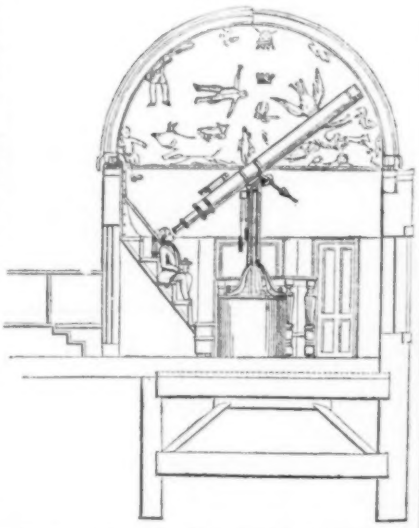
A, Reading room.—B, Observatory.—C, Observer's seat.—D, Reading table.—E, Pier of the tele

Upon the bed plate before mentioned, is placed a circular rail, twelve feet in diameter inside, three inches wide and one inch thick,—upon the upper surface is a raised bead or bearing. B, figure 4, is a sectional diagram. This rail was cast at the West Point Foundry, in one piece, and turned in a lathe, so that the bearing should not only be a true circle, but also smooth and level.

The dome is twelve feet in diameter, inside, the base being a counterpart of the curb, which constitutes the bed plate. It is built in the usual manner with ribs, sawed to the proper circle, of well seasoned pine, that it might be light, and with great care, that it might be an exact hemisphere.

Two stout ribs cross the dome, equidistant from the centre and fifteen inches apart, forming the aperture for the telescope; they are five inches wide and three inches thick, and are braced together on one

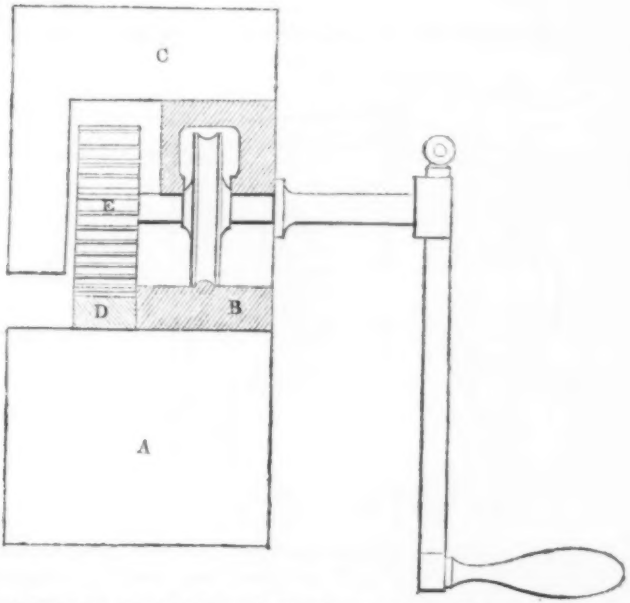
3.



Sectional view of the interior of the Observatory.

side, with four iron bands at equal distances, to strengthen the structure, and keep the ribs in their proper positions, as they are what may be termed the *railroad* of the door which closes the aperture. The dome is covered with tin, except the space between the two main ribs; on one side this space is covered with zinc, lapped sufficiently to exclude rain, and secured with screws, that it may be easily removed in case of any derangement of the chain or guide pullies, which this zinc covering overlies.

4.



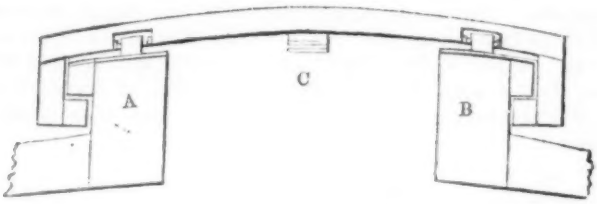
A, Wooden curb or bed plate.—B, Circular rail.—C, Base of the dome.—D, Rack encircling the rail.—E, The pinion.

The aperture extends a little beyond the zenith. It is closed with a sliding door, made to a circle exactly corresponding with the outer surface of the main ribs. The door is secured in the usual way, to exclude rain, and at the same time allow freedom of motion, that it may slip over the zenith to the opposite side. It is covered with tin, and made as light as possible, consistently with the requisite strength. See fig. 5.

The handle, for moving it, is at the horizon, just above the observer's seat, the power being conveyed to a pinion under the upper extremity of the door, near the zenith, by means of a chain passing up the side of one of the main ribs, over guide pullies.

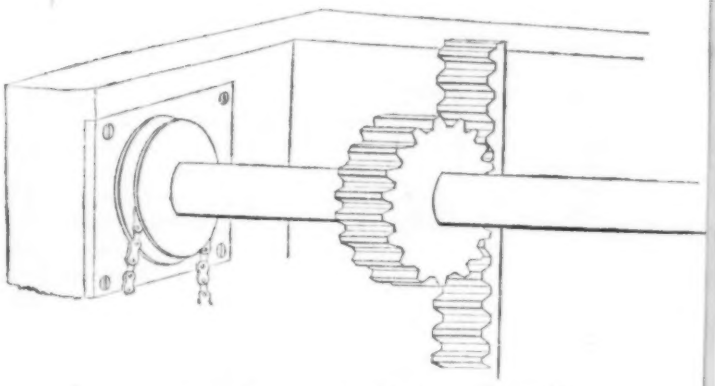
On the under side of the door is a rack, to fit the pinion. Figs. 5 and 6.

5.



A, B, The two main ribs.—C, Rack screwed to the under side of the door.

6.



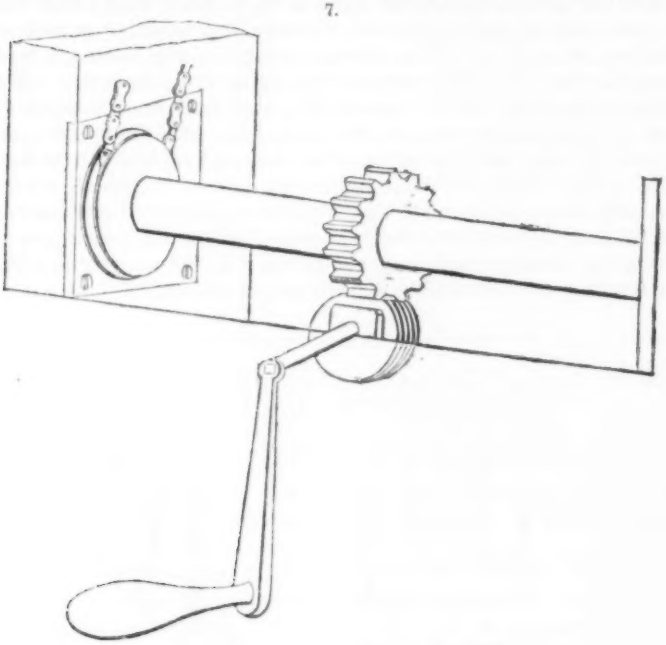
Pinion at the upper extremity of the door near the zenith.

An endless screw is introduced, fig. 7, which gives rather a slow motion, but has the merit of great ease, and of sustaining the door at any desired elevation. In order that the aperture may extend a little beyond the zenith, one foot of the door is disconnected and remains at the horizon, but may be elevated when necessary.

The machinery for turning the dome is very simple. It revolves upon seven small wheels of four inches diameter and one inch thick—in which grooves are turned to correspond with the bead on the iron rail. These wheels are fitted into cast iron boxes, and the boxes bedded equidistant in the base before mentioned. The shaft of one of these wheels is made long enough to receive a pinion at one end, and a handle at the other. The pinion fits a rack which encircles the rail, and is concealed from view. Fig. 4.

The handle and also the operator move round with the dome, which is accomplished in a very convenient manner, by the peculiar construction of the observer's seat. This is a small flight of

7.



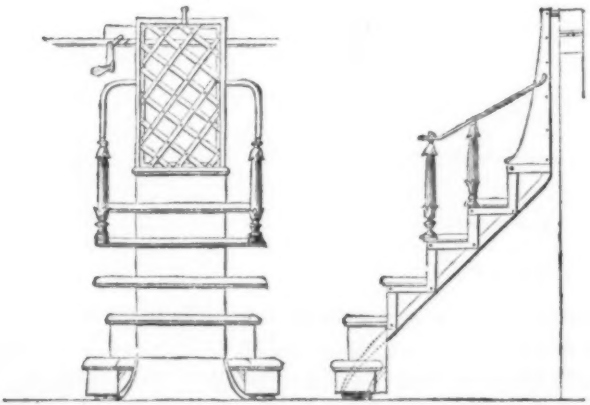
Endless screw and pinion on the horizon for moving the door of the aperture.

stairs, at an angle of elevation, suited to the sweep of the eye-piece, so that each step makes a convenient seat. Fig. 8. The frame is of wrought iron—the string pieces reach to the base of the dome, to which they are secured, as seen in the plans. The bottom of the stairs rests upon two wheels, in which grooves are made to suit a circular rail of half round iron, which is secured to the floor.

The handles for raising the door of the aperture and for revolving the dome, are near to each other, and can be easily turned by the observer. A circular platform or table is substituted for the ordinary reading steps. It is supported upon legs (with rollers) sufficiently long to give the observer command of the circles and equatorial machinery. The table is secured at both ends, to the bottom steps of the observer's seat, and consequently revolves with it, see figs. 2 and 3. It will be perceived that by this arrangement the aperture, the observer's seat, and the reading table are so constructed that the moving of one necessarily involves the

moving of all, and therefore they always retain their relative and proper positions. The pedestal or pier is simply a drum of boiler iron, three feet in diameter, and the same in height. It stands upon the three beams before mentioned, is lined with brick, like a well, and covered with a smooth round flag stone, projecting an inch over the iron. The mahogany frame of the telescope, having four feet, with adjusting screws, stands upon the stone. The steadiness of the pier is remarkable, and may be accounted for by the fact that the rock in the vicinity lies near the surface, and in many cases has been excavated to a considerable depth, to form the under cellars of the neighboring houses, which in a great measure serves to insulate the walls which support the telescope. A map of the Northern Hemisphere, with the figures, is painted upon the concave surface of the dome, and the stars to the fifth magnitude are represented in their proper places.

8.



Front and side view of the observer's seat.

The telescope is an achromatic refractor of eight inches aperture, 10 feet 6 inches focal length, made by Mr. Henry Fitz, of New York. It is furnished with six eye-pieces, of the Huygenian form, magnifying from 60 to 480 times, and has a finder of two inches aperture, and twenty-four inches focal length.

The stand is after the Frauenhofer plan, or the equatorial or parallactic style, but is made entirely of cast iron, excepting the circles, which are of brass. The axes are both cast hollow. The declination box and polar axis, being in one piece, as are also the saddle for the tube, and the declination axis.

It will be readily perceived that some method of securing the true position of the declination axes is required, and this is effec-

ted by means of an excentric bearing for the end of the axis, to which the circle is attached, and which is readily turned, within the declination box, until the adjustment is found to be correct, and then secured. A clock is attached to the telescope for keeping the object in the field of view, and an important improvement has been made in the manner of communicating the motion to the hour circle. The thread to fit the tangent screw, is cut in the edge of a ring, detached from the hour circle, and merely pressed against it on a conical bearing, by the elasticity of a thin brass plate, which is secured by four screws, that give the requisite friction.

This detached arrangement permits the telescope to be moved in any direction, while in connection with the clock, and obviates the necessity of clamping and unclamping, thereby greatly diminishing the danger of injury to the instrument.

ART. VIII.—*On the Phosphorescence of some Marine Invertebrata;* by M. A. DE QUATREFAGES.

SECOND PART.—*General observations on Phosphorescence.*

1. *Description of the phenomenon.*—It would be useless to repeat here all the details given by travellers; I will confine myself to some remarks on my own observations.

The phosphorescence of the sea has appeared to me under two different forms: 1st, a result of scintillations more or less numerous, always isolated, and not giving at all the idea of a liquid in itself luminous: 2nd, a general glow more or less uniform, the phosphorescent substance seeming to be dissolved in the water itself.

In both cases, phosphorescence is equally a result from living animals, directly emitting the light, but the species which produce the phenomenon are different.

A. I have often observed the first mode of phosphorescence on the western coasts of France, at points peculiarly exposed to the action of currents and waves. At Chausey, especially in the small channel called "le Sund de Chausey," I have seen very numerous and brilliant sparks brought out by each stroke of the oar. The track of the vessel seemed for a moment as if strewn with diamonds, but these sparks, always very brilliant, and appearing at the same instant, never communicated a general glow to the water. They remained completely isolated, and were distinct from the dark surface of the sea. At Brehat, St. Malo, and St. Vaast, I observed similar facts. The fishermen whom I questioned, all assured me that in these regions, the sea never presented a different appearance; the young men who had never left their native

coasts, did not seem to understand my inquiries relative to a more general or diffused phosphorescence. M. Beautemps-Beaupré, mentions his observing phosphorescence of this kind during one of the numerous excursions in which he was engaged, while making his magnificent atlas of the coasts of France. But he cannot recall the exact locality. It was in the neighborhood of St. Brieuc, and it may be that this single observation was made in some well sheltered harbor, like the port of Paimpol.

If the sea itself rarely presents any remarkable phosphorescence in the localities of which I am about to speak, it is not so with the marine plants which are left by the tide. In some circumstances, I have seen masses of the Fucus kindle up when seized a little rudely; but even then the light was in isolated points, which the eye easily distinguished from one another. In no case did the stalks or the leaves present the uniform tint of a metal at a white heat, and the water which ran out freely was never luminous. Moreover, the part of the beach which the sea had just left dry, remained perfectly dark. At most, only a few sparks might be seen over a space of some extent.

Water drawn from the sea in the circumstances of which I speak, and when the scintillations were most numerous and most brilliant, often became suddenly obscure, or presented only some few luminous points, when the vase containing it was violently shaken, and these ordinarily disappeared instantly. This same water poured out from some height, presented nothing peculiar. Never, in the regions of which I speak, have I seen the waves breaking on a shore presenting the appearance described by travellers.

B. The second kind of phosphorescence I saw for the first time near Stromboli. Here the effects of the light were heightened by the dark hue of the waves around the volcanic cone; moreover, at Boulogne, and probably at Havre, Dieppe, Ostend, &c., this phenomenon is as complete and interesting as at Stromboli.

At Boulogne, the phosphorescence is apparent throughout the harbor, except where the waters of the Liane flow into it. It is diminished and perhaps destroyed towards the entrance, between the two dykes. It is very decided through the whole port properly so called, in the basin, and especially in the little cove named the "Parc aux huitres." The last locality being very accessible, afforded opportunity for studying all the details of the phenomenon.

However favorable the circumstances for observation, the water when quiet was always perfectly dark; but the least movement drew forth light. A grain of sand cast upon the dark surface produced a luminous spot, and the undulations of the water were so many bright circles. A stone as large as the fist, produced the same results in a more intense degree, and moreover each

splashing occasioned a scintillation like that of a bar of iron at a white heat when struck upon an anvil. The entrance of a steamboat when the phenomenon was most apparent, was a magnificent sight, and recalled to mind the descriptions of travellers.

The "Parc aux huitres" was always bordered by a phosphorescent girdle, resulting from the incessant undulations of the sea, which reached the shore under the form of small waves; but in perfectly fair weather this light was too feeble to be distinguished at a distance. When these undulations were only three to four inches high, the ring might easily be seen from the pier, throughout its whole extent, and was especially marked in the inner part of this little harbor.

At Boulogne, as at Stromboli, these luminous waves seen from a distance, presented a uniform tint of a pale dull white. It might be called almost a froth, resulting from the action of the waves against the shore; and seen at mid-day under the most favorable circumstances, that was all I could distinguish at a distance of 70 to 80 yards. In proportion as you advance the appearance changes; the waves as they near the shore, seem crowned with a light bluish flame, which M. Becquerel has justly compared to that of a bowl of punch. When they strike, this brightness becomes whiter and more vivid. On reaching the bank, you often see these same waves under the aspect of surges of melted lead or silver, strewn with an infinite number of bright scintillations, either brilliant white, or of a greenish tinge. The spectacle is then most beautiful, and after having witnessed it on a small scale, I understood the impression left on the minds of travellers who have seen it under the tropics, in all its magnificence. The following are the facts which I have myself witnessed.

The waves in breaking on the nearly horizontal beach of the cove, although so little elevated, covered quite an extent, and the whole space presented a uniform and glowing tint, from which started out innumerable scintillations yet more brilliant, and of a bluish or greenish hue.

As the water became absorbed by the sand, a line more strongly luminous indicated its limit. This effect was especially marked in the little cavities which the shore presented, where the line formed concentric curves which diminished as these little basins were exhausted. On passing a long stick rapidly in the water, it presented in its whole length, the appearance of a blade of silver.

The water taken up at random and poured out from a little height had exactly the appearance of melted silver, and it was the same in the slightest spray. It left upon the hands or clothes bright spots that were quite persistent. At one time, when on a short excursion with M. Bouchard a dog ran barking at us, we threw at him the contents of a small cup, and he fled in terror from what he seemed to take for fire, and troubled us no longer

save at a distance. If we plunged our hands into the sea, when drawn out they were luminous all over, but after a few seconds, they were marked only here and there with bright spots, whose brilliancy remained constant and without scintillations.

The bank recently left by the tide did not however show any trace of phosphorescence; yet at the least shock, it became luminous, and seemed literally to glow under the steps of the observer. In some circumstances, wherever the foot rested on the sand or gravel, it seemed like burning coals beneath the tread, and this appearance was equally perfect, with more or less brilliancy, even to a distance of some inches.

The Talitri, so numerous on our sandy shores, and whose habits have gained for them from the fishers, the name of sand-flea, become luminous by contact with the phosphorescent water,—a fact to be noted; for at first one might be led to imagine that they were the cause of the light. Nothing can be more curious than to see these sand-fleas leaping by hundreds, and appearing like the scattering of tiny sparks.

2. *The Animals that produce the phosphorescence in the two preceding cases.—a.* At Chausey, Brehat, St. Malo, Saint Vaast, I have many times sought for the cause of the bright sparks, which I saw shining and then vanishing in darkness. In each case I met with living animals, and these animals were always Crustacea, Ophiura or Annelida. I usually found the first in the water drawn up either from channels or at some distance from the shore. The second were under stones, or in the masses of seaweed. It was especially to the Annelida that the Fucus owed its brilliancy.

These results explained all the circumstances of the first kind of phosphorescence. The Crustacea, whose movements are energetic and whose locomotion is extended, cannot easily be collected in sufficient quantity on a given point to have their scintillations appear like a uniform tint. Besides there is nothing in the habits of the species I have examined, to lead one to suppose that they are inclined to collect in numerous bands. The size of the Ophiura prevents such an idea with regard to them; and the smaller Annelid for a like reason cannot contribute to such a result. Thus the light produced by these different animals is always seen in points more or less near each other, but never really blended.

b. At Boulogne, on the contrary, we find this brilliant light exclusively due to Noctilucæ. With the most careful examination, I have never found in my vases a single Annelid, or a single phosphorescent Crustacean.

Many circumstances, some of which will be explained beyond, illustrate the particular mode of phosphorescence of the sea, rendered luminous by the presence of these Rhizopodes. We will

first notice their size and great number. The diameter of these Noctilucæ, varies from about $\frac{1}{5}$th to $\frac{1}{3}$th of a millimeter; but their abundance more than compensates for their minuteness, each drop of water, as observed by Suriray and M. Verhaeghe, containing one or more. The following calculations will give some idea of their vast numbers.

In taking up some water at random from a brilliant wave, I filled a tube about a decimeter in height. After being left a little time quiet, the deposition of Noctilucæ on the surface of the liquid was about $1\frac{1}{2}$ centimeters in thickness. Thus the Noctilucæ composed about $\frac{1}{7}$th of the phosphorescent water. Again I took the water from the surface and filled a vessel about one-half. The whole height of the liquid was about 15 centimeters, and that of the mass of Noctilucæ was about five centimeters; here the proportion was about $\frac{1}{3}$. Finally, I remember that at False Bay, M. de Tessan found the proportion equal to $\frac{1}{2}$. From these numbers, it is easy to understand how the sea, rendered luminous by the Noctilucæ, may present a uniform brilliancy, irresistibly impressing the idea of a phosphorescent solution. When the surface of the sea is tranquil, as in a well protected harbor, the Noctilucæ, because of their small specific gravity, form a continuous bed, and the least movement is sufficient to cover that dark surface with a brilliant mantle. When the movement of a vessel at once breaks in upon this mass of Noctilucæ, and also calls out their simultaneous phosphorescence, the myriads of bright points lying in the trough of the wave, present one universal hue. From a distance, the eye sees throughout a uniform brilliancy, and near by distinguishes only the most brilliant scintillations or those thrown out by the animals at the immediate surface of the water. These brilliant waves are like so many nebulæ resolved by the eye only in part.

Part Third.—*Observations and Experiments on the Light of the Noctilucæ.*

[Instead of giving a full translation of this Part of the memoir as has been done of the preceding, we offer here an abstract presenting in brief the conclusions of the author.—Eds.]

1. ***In a sea rendered phosphorescent by Noctilucæ, the light proceeds only from the body of these animals.***—This proposition is proved by direct microscopic examination;—and by the water's being deprived of all light when the Noctilucæ are filtered out, and becoming luminous again when they are restored to it. In a tube, of the seawater, the Noctilucæ if left quiet soon form a layer at the top of the liquid, and the light is confined entirely to this layer of the animals.

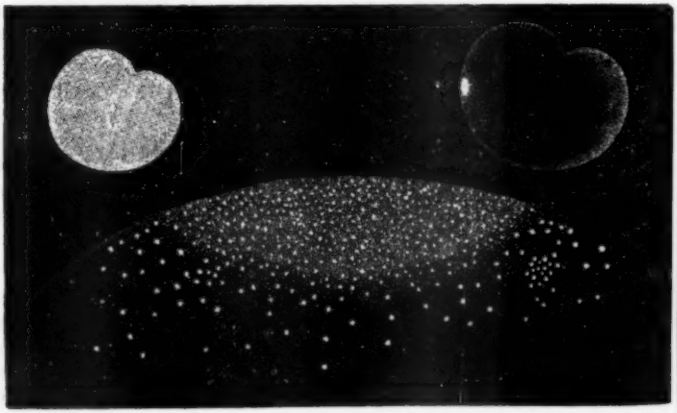
2. ***The production of light is independent of contact with the air.***—The flashes of light that are produced with the breaking of every wave might seem to show that the access of the animals

to the external atmosphere was essential to the result. But on the contrary, it is found by observation that in a vase of seawater containing the Noctilucæ, the bed of these animals that collects at the top of the vase is equally luminous in every part.

3. *Color of the light.*—When the Noctilucæ are in full vigor of life in quiet water, the color is a clear blue. But on agitating the water, or in the waves of the sea, the light becomes nearly or quite white or like silver sprinkled with some greenish or bluish spangles.

4. *Intensity of the light.*—M. de Tessan states that in some tropical seas, the phosphorescence is so bright from the breaking waves, that he could read ordinary type at a distance of fifteen paces. The light from the Noctilucæ cannot compare with this. At the head of the cove of the "Parc aux Huîtres" at Boulogne, it was not possible to tell the hour with a watch, when the waves were breaking at the observer's feet. With a tube 15 millimeters in diameter, in which the Noctilucæ formed a bed at the surface nearly 20 mm. thick, the figures of a watch face could be read; but strong agitation of the tube was necessary, and it was requisite to hold it close to the glass of the watch. Four to five teaspoonsfull of Noctilucæ were collected in a filter, and on producing the phosphorescence by this means, the hour could be told at the distance of a foot.

5. *No disengagement of heat sensible to a thermometer accompanies the phosphorescence.*—This fact was established by placing the bulb of a thermometer in the Noctiluca water while it was quiet, and then giving it a shake to produce the phosphorescence. The experiment was varied in different ways.



6. *The light of the Noctilucæ may be produced over the whole surface of its body or only a part of it.*—After a violent agitation, the Noctilucæ retain the phosphorescence for some time, so that it may be studied at leisure. With a lens magnifying 6 to 8 diameters, it is easy to see that while some of the Noctilucæ are phosphorescent throughout, others are but partially so. In the figure given above, one of the animals is light over its whole surface,

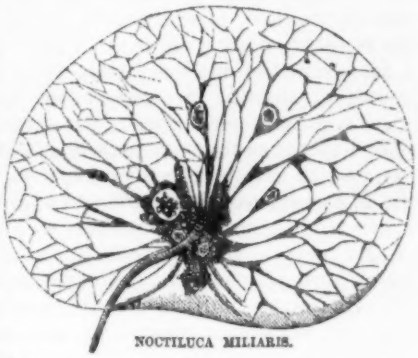
and the other only on opposite sides. With a lens of 10 to 12 diameters, we find that the light often appears successively on different parts of the body. There is hence no circumscribed phosphorescent organ, as in the Lampyri, Elaters, and Pyrosomas.*

7. *The light is due to an infinite number of minute scintillations.*—The preceding figure of a part of a Noctiluca much magnified, represents the actual character of the phosphorescence. There is an immense number of points of light. With a lens of 20 to 30 diameters, the light is like an undefined nebula; but with a lens of 60 diameters, it is partially resolved, and with 150 diameters, wholly, into its constituent spangles. Each luminous spot on the body is found to consist of a cluster of minute instantaneous scintillations, dense at the centre, and more scattered towards the circumference of the spot. Thus the same phenomena take place in the Noctilucæ as were observed by M. de Quatrefages in the Ophiuræ and Annelida. Each spot of light is resolvable into constituent points, and consists of evanescent scintillations.

8. *The light from the dead Noctilucæ or from fragments of them, is identical with that from the vigorous living animal.*—When the light of the Noctilucæ, after frequent excitement, becomes white, it is also more fixed, and finally covers the whole body. From numerous experiments, M. de Quatrefages concludes, that this kind of light is evidence of disease, or of a decline of vigor, and when the light is universal, of death. Microscopic examinations make it apparent that in these cases the light is still made up of minute points, and it is evidently of the same nature with the light given out in active life.

9. *Precautions necessary to succeed in the preceding observations.*—The animals should be examined without the use of a compressor; and care should be taken in employing high powers, not to be deceived by the light proceeding from a point not quite in the focus, whose rays produce a confused image, as if the light were uniform instead of localized. This illusion is difficult to

* The Noctiluca has a depression on one side, and near the middle of this depression is the mouth. At the same place there is a moveable appendage as long as half the diameter of the animal. The body is perfectly transparent. The general envelop consists of two membranes, distinguished with difficulty. The outer is excessively thin and like an epidermis; the inner is thicker, but without a trace of fibres. On compression the envelop acts like a bag full of liquid, and finally bursts. Numerous anastomosing and branching lines radiate from the mouth through the granulous interior.



NOCTILUCA MILIARIS.

avoid with fragments, as they are apt to be folded, so as to bring more than one point of light in the focus at once.

10. *The phosphorescence is not the result of a kind of combustion.*—On taking a barometer tube nearly filled with mercury, putting in some seawater containing Noctilucæ (the water occupied six centimeters of the tube, and the bed of Noctilucæ was three centimeters thick), and then inverting it over mercury, a phosphorescence was produced of the pale white light which indicated approaching death, a consequence of the imperfect vacuum. After one hour and eighteen minutes, the phosphorescence had ceased, and could not be restored by shaking it. Oxygen gas was introduced without effect. It is probable that the phosphorescence, if due to combustion, would have been restored by the oxygen, as happens with the Lampyri, according to Matteucci, under similar circumstances.

Four tubes were filled with water containing the Noctilucæ. Into one, oxygen was poured, into the second, hydrogen, the third, carbonic acid, the fourth, chlorine. The first three gases produced the same effect, and not more than atmospheric air occasions through the agitation its passage causes. After half an hour these tubes were shaken with precisely the same result in all. Chlorine acted like other irritating agents; the light was at first bright and continuous, but rapidly became extinguished. Macaire and Matteucci have shown that the light of the Lampyri is immediately brightened in oxygen, and rapidly extinguished by carbonic acid. The light therefore cannot be alike in origin in the two cases.

11. *All physical agents that produce contractions cause phosphorescence, and in proportion to the intensity of the contractions.*—This conclusion was established by M. de Quatrefages by experiments upon the influence of pressure, heat and electricity; of sulphuric, nitric, muriatic and sulphydric acids; potash, ammonia, alcohol, ether, turpentine, common salt, Owen's liquid, milk, fresh water. With very dilute sulphuric acid, the excitation is strongly marked, attended with a rupture more or less rapid of the filaments uniting the interior mass to the envelop, and finally a detachment of the mass from the envelop, and a withdrawal towards its mouth. A portion of the inner mass and tissues, may cover still the inner surface of the envelop; but after a while they come away from the envelop, and collect about the mouth, leaving the envelop empty. In the dark, there is a very brilliant light at the first contact of the dilute acid with the Noctilucæ; then afterwards there appears a clear fixed white light on one part, which rapidly spreads, till the whole is like a ball of silver. The brilliancy soon after begins to diminish, and rather rapidly disappears. The rupture of the fibres and disorganization of the interior mass, evidently take place consentaneously with the flashes and change in the light.

It is hardly necessary to cite the other experiments in this place. M. de Quatrefages concludes that the light is produced by the contraction of the interior mass of the body; that the scintillations are owing to the rupture and rapid contraction of the filaments of the interior, and that the fixed light which these animals emit before dying, proceeds from the permanent contraction of the contractile tissues adhering to the inner surface of the general envelop. The production of the light is independent of all material secretions. Whether it is accompanied by a discharge of electricity or not, remains to be ascertained.

ART. IX.—*Contributions to Meteorology—Mean Results of Meteorological Observations, made at St. Martin, Isle Jesus, Canada East, (nine miles west of Montreal,) for* 1852; by CHARLES SMALLWOOD, M.D.*

Barometric Pressure.—The readings of the barometer, are all corrected for capillarity, and reduced to 32° F. The means are obtained from three daily observations, taken at 6 A.M. 2 P.M. and 10 P.M.

The mean height of the barometer in January, was 29·607 inches, in February 29·902, in March 29·952, in April 29·470, in May 29·539, in June 29·489, in July 29·555, in August 29·668, in September 29·645, in October 29·689, in November 29·615, and in December, 30·011 inches.—The highest reading was in December, and indicated 30·329 inches, the lowest was in June and was 28·727 inches; the *yearly mean* was 29·686 inches, the *yearly range* was equal to 1·602 inches.—The atmospheric wave of November was marked by its usual fluctuations, the final trough terminated on the 30th day.

Thermometer.—The mean temperature of the air in January, was 12°·65, in February 21°·90, in March 20°·7, in April 38°·38, in May 52°·27, in June 66°·12, in July 72°·33, in August 68°·02, in September 59°·15, in October 45°·69, in November 33°·0, in December 24°·64 F.

The highest reading of the maximum thermometer, was in July, and marked 100°·5; the lowest reading of the minimum thermometer was in January, and was −28°·0. The mean temperature of the quarterly periods, was, winter 16°·45, spring 37°·11, summer 68°·82, autumn 45°·94. The *yearly mean* was 42°·86, and the *yearly range* 128°·5. The greatest intensity of the sun's rays was in July, and indicated 122°·5, the least intensity was in November, and was 62°·4.

The mean humidity of the atmosphere in winter was ·781, in spring ·806, in summer ·810, and in autumn ·895. The *yearly mean* of humidity was ·823.

* The geographical co-ordinates of the place are 45° 32′ N. Lat., and 73° 36′ W. Long.: height above the level of the sea (estimated) 30 feet.

Rain fell on 88 days, amounting to 47·131 inches and was accompanied by thunder and lightning on 17 days.—*Snow* fell on 48 days amounting to 84·61 inches *on the surface.* The equivalent of 1 to 10 as used by the Smithsonian Institute at Washington, for the comparison of melted snow to rain, does not hold good in this climate: it varies from 1 to 5 to 1 to 8. I have undertaken a series of experiments on this point, which I have not at present brought to a close.

The whole amount of snow which fell in the winter 1851–2, amounted to 95·920 inches; the first snow fell on the 25th of October, 1851, and the last on the 16th of April, 1852.

The amount of evaporation was regularly measured and recorded during that period of the year, when the thermometer stood above the freezing point, and owing to frosty nights, and frost also during some days, no accurate measure could be taken. The amount of evaporation in May, was 3·720 inches, in June 3·450, in July 4·150, in August 2·620, in September 2·020, and in October 1·220: this period includes what I consider could be taken with anything approaching to accuracy.

The most prevalent wind during the year was the West, the next in frequency was the E. N. E., the least prevalent wind was the N. by W. The mean of the maximum velocity (as measured by an anemometer similar in construction to Dr. Robinson's) was 17·632 miles per hour; the mean minimum velocity was equal to 0·463 miles per hour.

The Aurora Borealis was visible on thirty-six nights, at the following hours, and its appearance was generally followed by rain in summer and snow in winter.

January 19*th*, 10 P. M. Faint auroral arch—sky clear; 26*th*, 10 P. M. Do., dark clouds in the horizon.

February 15*th*, 4 A. M. Bright aurora in the north, streamers shooting to the zenith; sky clear.—19*th*, at 6·30 P. M., the heavens presented a curtain or canopy of auroral light; streamers of yellow, green and crimson were sent up in rapid succession from the horizon to the zenith, where they formed a cupola or corona near *α Aurigæ;* at the horizon, the arch extended from E. to N. W. Stars of the 4th and 5th magnitude were visible through these magnificent curtains of auroral light. These appearances lasted about 30 minutes, and then gradually faded away, as if to seek a rest, and to shine forth with still greater splendor; for at 10 P. M., the northern horizon presented a low auroral arch of a yellow color, while in the southern horizon stretching from E. to W., a most splendid display of streamers rose to an apex, about 60° above the horizon; the streamers were of the same color, as in the former part of the evening; these appearances lasted 20 minutes; the northern arch remained still visible. Volta's No. 1, electrometer, marked 0·76 positive electricity; there was no change indicated, during, or after the phenomenon.—20*th*, 10 P. M. Low auroral arch in the north, very faint; sky clear.

March 7th, 7 P. M. Faint aurora, occasional streamers; sky clear.—*19th*, 10 P.M. Low auroral arch, bright; sky clear.—*20th*, 9 P. M. Faint auroral arch; sky clear.

April. No aurora observed this month.

May 5th, 10 P. M. Faint auroral patches, sky clear.—*6th*, 10 P. M. Faint auroral arch; sky clear.—*18th*, 10 P. M. Faint auroral arch, horizon clouded.

June 11th, 8·45 P.M., the heavens presented an auroral arch 3° broad of great magnificence; the arch commenced in the E. at the horizon, stretching to the zenith, and descending nearly due west to the horizon; the color was crimson, at other times pale green; the borders or edges were well defined. Stars of the 4th and 5th magnitudes, were distinctly visible through it; a few *light cirri* were discernible in the eastern horizon, but otherwise the sky was clear; a faint auroral light was visible in the north. The arch vanished at 9·20 P. M. The electrometer marked 0; wind west, velocity 1·10 miles per hour.—*15th*. Low auroral arch from E. to W. N. W., bright yellow color; occasional streamers to the zenith, from 9·40 to 11·10 P. M.—*23d*, 11·40 P. M., faint auroral light, sky clear.

July 5th, 10 P. M. Auroral bow stretching from E. to W. N. W., 2° wide and bright; sky clear. Wind south, velocity 0·12 miles.—*6th*, 10 P. M. Auroral light in the north, moderate brightness; streamers; sky clear.—*7th*, 10 P. M. Patches of auroral light, or clouds from E. N. E. to W. S. W., which vanished leaving a broad auroral arch; sky clear.—*10th*, 10 P. M. Auroral streamers, bright. *Cumul. Strat.* 4. *20th*, 9 P. M. An arch of light auroral clouds, 1° in width, passing through the constellations Cygnus, Lyra and Hercules to the horizon, lasted 20 minutes, sky clear, wind S. W., velocity 6·26 miles.—*29th*, 8 P. M. Auroral arch bright. *Cumul. Strat.* 3. Heat lightning very vivid.

August 5th, 10 P. M. Very faint auroral light. *Cirr. Cuml.* 4.—*6th*, 10 P. M., do. *Cuml. Strat.* 4.—*10th*, P. M. Bright auroral arch broad; dark segment underneath; sky clear.—*11th*, 10 P. M. Faint auroral clouds in the north; sky clear.

September 3d, 10 P. M. Faint auroral light; sky clear.—*4th*, 10 P. M., do.—*16th*, 10 P. M. Bright auroral arch, extended and sending up occasional streamers; sky clear.—*17th*, 10 P. M. Faint auroral arch, low, sky clear; *18th*, 10 P. M., do.—*29th*, 10 P. M. Floating auroral clouds, varying in brightness; sky clear.

October 6th, 10 P. M. Masses of auroral clouds in north of moderate brightness. *Cirr. Cuml.* 4.—*19th*, 10 P. M. Auroral arch faint and low. *Stratus* 2.—*20th*, 9 P. M. Faint auroral arch, with dark segment underneath, at 9·20, a fine display of streamers; sky clear.

November 11th, 10 P. M. Bright auroral streamers, not very extended; sky clear.

December 1st, 3 A. M. Auroral light in the north, bright and extended; sky clear.—*29th*, 10 P. M. Low auroral arch; sky clear.

Lunar halos visible on six nights. A *lunar rainbow* was also visible on the 29th February. *Fogs* were observed on six mornings. *Shooting stars* were seen on the 18th of July and 9th and 10th of August. A slight shock of an *earthquake* was felt on the

11th of February at 5·40 A. M., barometer 29·067, thermometer 38·5, wind E. by N., velocity 6·00 miles per hour; the *wave* came from the W. N. W. The barometer continued to fall until 11 A. M., it was then 28·892 accompanied by slight rain (0·50 inch); the wind veared about noon by the N. to the W. S. W., and increased to a velocity maximum 30·57 miles per hour, which continued during the day following; wind W. N. W.

Electrical state of the atmosphere.—The atmosphere has afforded indications of electricity, varying in intensity on every day or nearly so, during the year, and was *generally* of a *positive* or *vitreous* character. Two remarkable *electrical storms* occurred on the 23d and 31st of December, indicating an intensity of 450° in terms of Volta's electrometer, No. 1: sparks of $\frac{5}{4\,6}$th of an inch were constantly passing from the *conductor* to the *discharger* for several hours each day: it was of a *positive* character, with frequent and quick changes to negative electricity. An increase of intensity is always observed during the snow storms of our winter; this increase generally possesses the character of positive electricity, although frequent signs of negative electricity have been observed here; this change from positive to negative electricity appears to be connected with change in the form of the crystals of snow. The crystals of snow in this climate during the very severe weather, are generally those described by Scoresby, and figured from 16 to 20 in Kæmtz's Meteorology, also fig. 3; and plain hexagonal prisms have likewise been observed.

St. Martin, Feb. 1, 1853.

Art. X.—*Mr. Blake's Reply to Mr. Hendrick's Review of his article on the Flow of Elastic Fluids.*

The following will be found to be a sufficient answer to the criticism of Mr. J. E. Hendricks, in the last number of this Journal, upon my article on the flow of elastic fluids published in No. 12, vol. v, second series, of this Journal.

When Mr. Hendricks expresses the pressure by P*t*, he should also express the quantity discharged by VDS*t*. He may then eliminate *t* and obtain an expression identical with my own, whether the value of *t* be *cypher* or unity or any other quantity. Hence there is no ground for the distinction he would make between "*momentary*" and other forces.

I avail myself of this opportunity to direct attention to an error of the engraver of the plate which illustrates the results of my experiments on the flow of elastic fluids, at page 191, vol xii, second series, of this Journal. The figures at the left of the plate (18, 19, 20, &c.) should all be moved upward so as to bring the number 30 against the upper line of the plate.

ART. XI.—*Contributions to Mineralogy;* by Dr. F. A. GENTH of Philadelphia.

1. *Tetradymite.**—The uncertainty in regard to the chemical constitution of tetradymite renders it desirable, that this mineral should be re-analyzed in order to ascertain, whether it may be considered a tertellurid of bismuth, in which a variable quantity of tellurium is substituted by sulphur, or a combination of one equivalent of tersulphid with two equivalents of tertellurid of bismuth. Several years ago I discovered this rare mineral at a new locality, viz.: Davidson County, N. C., about five miles west of Washington mine.

It occurs there in foliated scales and lamellar masses of splendent metallic lustre, and between lead- and steel-color. H. =1·5; sp. gr. =7·237 (at 7° Cels.).

B.B. on charcoal it fuses readily, tinging the flame blue and giving off the odor of sulphurous acid and slightly that of selenium, leaving white incrustations with a yellow ring next to the substance. In an open tube it gives off white fumes and a sublimate of tellurous acid.

Only a few specimens came from this locality, and as they were found near the surface, a great portion of the tetradymite was already oxydized. This oxydized portion contains but a small quantity of carbonate of bismuth; the greater part seems to be a combination of tellurous acid with teroxyd of bismuth, and, as it yields chlorine when dissolved in hydrochloric acid, some of the tellurium is oxydized into telluric acid.

The accompanying minerals are gold, copper pyrites, magnetic iron, brown hematite, epidote, quartz, etc.

The substance for analysis was first treated with very diluted hydrochloric acid, in order to free it from the oxydized minerals, and then picked out. The pure scales were washed and dried. 0·9039 grms. were dissolved in nitrohydrochloric acid, and the sulphuric acid formed in this manner precipitated by chlorid of barium; the sulphate of baryta was filtered and first washed with diluted hydrochloric acid, finally with water. The dry sulphate of baryta was powerfully ignited, and after cooling, digested with diluted hydrochloric acid, filtered, washed and weighed. It was 0·4064 grs. This precaution, though not generally in use, is of the greatest importance for a correct determination of sulphuric acid (resp. sulphur) in all cases in which nitric acid is also in solution. It is well known, that in its presence a large portion of nitrate of baryta always falls down along with the sulphate of baryta. This nitrate of baryta cannot be washed out completely,

* An abstract of this paper was published in Keller-Tiedemann Nordamerikanischen Monatsbericht, ii, p. 249.

not even with boiling water; the best mode to get such sulphate of baryta pure is to decompose the nitrate of baryta by heat, and to extract the caustic baryta afterwards with diluted hydrochloric acid.

After freeing the filtrate from the excess of chlorid of barium by sulphuric acid, the solution was treated with hydrosulphuric acid, and from the precipitate thus obtained, tellurium was separated by digestion with sulphid of ammonium. The filtrate containing it, was evaporated nearly to dryness and oxydized with nitrohydrochloric acid, the nitric acid removed by evaporation with an excess of hydrochloric acid and the tellurium then precipitated by bisulphite of ammonia. This metal filtered upon a filter of known weight was found to be 0·3000 grs.

The precipitate of tersulphid of bismuth was dissolved in nitric acid and precipitated from the boiling solution by carbonate of ammonia. The carbonate after ignition gave 0·6067 grs. teroxyd of bismuth. The filtrate of the mixed precipitate of the sulphids of bismuth and tellurium was oxydized by nitric acid and the sesquioxyd of iron precipitated by ammonia. It was 0·0115 grs. The iron being an impurity in tetradymite was calculated as iron pyrites and subtracted from the original weight. Thus the analysis gives as the composition of this tetradymite:

Bi 61·351 Te 33·837 Se *trace* S 5·270=100.458

$$\frac{61{\cdot}351}{207{\cdot}996} : \frac{33{\cdot}837}{64{\cdot}141} : \frac{5{\cdot}270}{16{\cdot}060} = 0{\cdot}295 : 0{\cdot}528 : 0{\cdot}308$$

This ratio does not very well correspond with the formula $BiS_3 + 2BiTe_3$, for which the calculated per-centage would be:

Bi 59·033 Te 36·409 S 4·558

The analyses of the tetradymite from Schubkau in Hungary, by Berzelius and Wehrle, and that of the same mineral from Whitehall in Virginia by C. T. Jackson, (the latter after subtraction of gold, &c.) give:

		Berzelius.	Wehrle.	C. T. Jackson.
Bi	-	58·30	60·0	60·31
Te	-	36·05	34·6	35·95
S	-	4·32	4·8	3·74
		98·67	99·4	100·00

It will be seen, that Berzelius's analysis accords better with the above formula than that of Wehrle, and that mine is very similar to the latter.

I will now compare these analyses with the formula $Bi(Te, S)_3$, considering the quantity of tellurium as correct. After calculating for it the requisite quantity of bismuth to form $BiTe_3$, I take the difference as BiS_3 and get in this manner the following per-centages:

		Genth.	Wehrle.	Berzelius.	Jackson.
Bi	-	61·19	60·7	60·07	59·33
Te	-	33·84	34·6	36·05	35·95
S	-	4·97	4·7	3·88	4·72

My own and Wehrle's analyses speak decidedly in favor of the latter formula, and even Berzelius's analysis shows but a slight difference in respect to bismuth and sulphur.

The composition of tetradymite therefore appears to be $Bi(Te, S)_3$; but it cannot be regarded as a settled question, since we have only a few analyses of this rare substance which allow of a fair calculation. Jackson's analysis is deficient either in sulphur or in tellurium, and the 60·31 p. c. of bismuth require 1·23 p. c. of sulphur (or an equivalent quantity of tellurium) more than he found, in order to have 3 equivalents of the electro-negative elements in combination with one of bismuth. In regard to selenium my experiments agree with those of Dr. Jackson. Before the blowpipe it gives off fumes of sulphurous acid quite distinctly, and judging from the intensity of the horse-radish odor, there cannot be a large quantity of selenium in the mineral.

Dr. Jackson remarks, that he observed impressions of the edges of crystals of tetradymite in metallic gold. I have in my cabinet a magnificent specimen of native gold from Whitehall, which appears to be a pseudomorph of tetradymite. I intend making a thorough examination of it and will describe it as soon as I find leisure to do so.

2. *Gray Copper* (probably a new mineral*).—At McMackin's mine, Cabarras County, N. C., I found a mineral associated with carbonate of magnesia, talc, blende, iron pyrites and galena, which is closely allied to some argentiferous gray coppers. As no locality in the United States of a similar mineral has yet been made known, an examination of it, I thought, might give interesting results.

Massive, apparently without any crystalline structure: H. = 4·5; sp. gr. ? —; color nearly iron black, subtranslucent, when in very thin splinters with cherry-red color; streak brownish-red; lustre submetallic; fracture conchoidal; brittle.

B.B. on charcoal it fuses readily = 1, makes incrustations of antimony and zinc, and gives off the odor of arsenic and sulphurous acid; with carbonate of soda on charcoal yields a globule of silver and copper. Soluble in nitrohydrochloric acid with separation of chlorid of silver.

0·1330 grs. were dissolved in nitrohydrochloric acid, the liquid diluted with a large quantity of water, and the chlorid of silver filtered off. It gave 0·0140 grs. silver. The filtrate was almost evaporated to dryness, the arsenic acid reduced by bisulphite of ammonia, the excess of the latter decomposed by hydrochloric acid, and copper, arsenic and antimony precipitated by hydrosulphuric acid. The precipitated sulphids were filtered and treated

* Read before the Acad. of Nat. Sci. of Philad., Feb. 15, 1853.

with sulphid of ammonium. The remaining sulphid of copper was dissolved in nitric acid and the oxyd of copper precipitated from the boiling solution by caustic potash. It gave 0·0512 grs. The filtrate from the sulphid of copper was saturated with hydrochloric acid and the precipitated sulphids of arsenic and antimony oxydized by chlorate of potash; chlorid of ammonium, tartaric acid and ammonia were added, and the arsenic precipitated by sulphate of magnesia as arseniate of magnesia and ammonia. This precipitate contained 0·008 grs. of magnesia.

The filtrate from the precipitate by hydrosulphuric acid gave, after having been oxydized by nitric acid, 0·0027 grs. sesquioxyd of iron, precipitated by ammonia; the filtrate from it gave with sulphid of ammonia a precipitate which yielded 0·0042 grs. of oxyd of zinc.

Sulphur and antimony were determined from the loss and by calculation. The analysis gave:

Ag	10·53 p. c.	which require	1·57	sulphur for	Ag S	
Cu	30·73 "	"	7·80	"	Cu_2S	11·43
Zn	2·53 "	"	1·25	"	Zn S	
Fe	1·42 "	"	0·81	"	Fe S	
As	11·55 "	"	7·42	"	As_2S_3	14·05
Sb	17·76 "	"	6·63	"	Sb_2S_3	
S	25·48 "					
	100·00		25·48			

The ratio of sulphur of the sulphobasis and sulphoacids is: 11·43 : 14·05 or 1 : 1·23, corresponding with the formula,

$$5(Ag, Cu_2, Zn, Fe)S + 2(As, Sb)S_3$$

It will be seen that this composition differs from that of gray copper, which is $4(Ag, Cu_2, Zn, Fe)S + (As, Sb)S_3$. As I had but a small quantity of this mineral for analysis, I prefer describing it at present as a variety of gray copper until further experiments prove that they are different.

3. *Apophyllite.*—The analyses of apophyllite from different localities show such a difference in the quantity of fluorine present (varying from 0·34 to 1·54 p. c.), that Rammelsberg suggested it might be a silicate in which a part of the oxygen is replaced by fluorine.

Mr. Edwin L. Reakirt analyzed in my laboratory the beautiful apophyllite from the Bay of Fundy, Nova Scotia.

It is known, that several varieties of apophyllite readily undergo a change in appearance, somewhat similar to that of Laumonite. In all the specimens which I had a chance to examine, it began with the octahedral faces, which became white and opaque, like semi-opal, whilst often the greater portion of the crystals remained vitreous and unchanged. Bergen Hill, N. J., afforded many specimens of this kind. I am not aware that investigations have ever been made in order to determine, whether the opaque and

vitreous apophyllite has the same composition, thus indicating dimorphism, or whether it is a pseudomorph in the form of apophyllite, caused by a commencing decomposition of the latter. Some of the differences in previous analyses may be attributed to a want of care in separating the opaque from the vitreous portion.

The material for Mr. Reakirt's analyses came from a large crystal, which was perfectly vitreous and not in the least decomposed. The form of the crystal was the square octahedron with the second prism.

The powdered mineral was dried over sulphuric acid.

I. 1·1671 grs. mixed and covered with freshly ignited oxyd of lead lost by ignition 0·1945 grs. of water.

II. 3·8700 grs. were fused with carbonate of soda, the fused mass was digested with water and filtered from the residue. This was dissolved in hydrochloric acid, the silicic acid separated by evaporation to dryness. The dry mass was moistened with hydrochloric acid and the silicic acid (*a*) filtered. The filtrate from the watery solution containing also a considerable portion of silicic acid, was precipitated by carbonate of ammonia and the silicic acid (*b*) filtered and weighed with the other portion: *a* and *b* weighed 2·0321 grs.

From the filtrate of silicic acid (*b*) a mixture of fluorid of calcium and carbonate of lime was precipitated by chlorid of calcium. Both were filtered, and after being ignited, treated with acetic acid, the excess of acetic acid evaporated in a water-bath and the insoluble fluorid of calcium separated from the acetate of lime by boiling water. It gave 0·1438 grs.

Lime was precipitated from the filtrate of silicic acid (*a*) by oxalate of ammonia and ammonia, which precipitate gave 1·7234 grs. carbonate of lime.

III. 1·4570 grs. were fused with carbonate of soda and the fluorid of calcium determined as in II. It gave 0·0491 grs.

IV. 1·9708 grs. were dissolved in hydrochloric acid and evaporated to dryness; the dry mass was moistened with hydrochloric acid and filtered. The silicic acid, thus obtained with addition of a small quantity from the silicofluorid, weighed 1·0384 grs.

The filtrate from the silicic acid was precipitated by ammonia and the small quantity of silicofluorid of calcium fused with carbonate of soda. The silicic acid was determined as in II (*b*), and added to that separated by hydrochloric acid. The lime was also added to the other portion of it. The filtrate from the silicofluorid was precipitated by oxalate of ammonia. It gave 0·8484 grs. carbonate of lime.

The filtrate was evaporated to dryness and the ammoniacal salts driven off by heat. The residue was acidulated with a little hydrochloric acid to convert the carbonate of potash which on

heating with oxalate of ammonia is always formed, into chlorid of potassium, evaporated, heated and weighed. It gave 0·1602 grs. chlorid of potassium. The composition of this apophyllite is therefore:

	I, II and IV.	I, III and IV.	Mean.		
SiO_3 - -	52·51	52·69	52·60	contains oxygen	27·18
CaO - -	24·99	24·77	24·88	"	7·08
KO - -	5·14	5·14	5·14	"	0·87
Fl - -	1·79	1·63	1·71		
HO - -	16·67	16·67	16·67		14·81
	101·10	100·90			
Oxygen equiv. with Fl =	0·76	0·69			
	100·34	100·21			

Not taking any fluorids into calculation but their equivalent oxyds, the ratio of oxygen, $KO:CaO:SiO_3:HO = 0{\cdot}87:7{\cdot}1:27{\cdot}1:14{\cdot}8$ or almost exactly what Berzelius found, 1 : 8 : 30 : 16 giving the formula $KO, 2SiO_3 + 8CaO, SiO_3 + 16HO$.

It is not improbable that a variable quantity of oxygen may be replaced by fluorine and that the general formula is:

$$K(O, Fl), 2Si(O, Fl)_3 + 8Ca(O, Fl), Si(O, Fl)_3 + 16HO.$$

4. *Allanite* from Orange County, N. Y.—I find a statement in Dana's Mineralogy, p. 681, based upon an analysis of T. H. Garrett, that the massive pitch-black mineral from Orange County, which had been considered an allanite, did not contain any cerium. I am indebted to W. S. Vaux, Esq. for a specimen from this locality. Mr. Edw. L. Reakirt analyzed it in my laboratory and found that it contains both oxyds of cerium and lanthanum. After the silica and alumina were separated as usual, the residue, insoluble in caustic potash, was boiled with oxalic acid and the white crystalline precipitate filtered after cooling. This oxalate on ignition yielded a reddish brown oxyd, from which nitric acid, diluted with about 200 parts of water, extracted a small quantity of lanthana. The remaining oxyd gave all the characteristic reactions of cerium. The mineral from Orange County is therefore allanite.

(*To be continued.*)

ART. XII.—*Review of the Geological Report on Wisconsin, Iowa and Minnesota, and incidentally of a portion of Nebraska Territory.*

IN our March number of this year, we gave a brief bibliographical notice of this work, soon after it issued from the press; but being the final Report of an important and very extensive geological exploration of the Northwest, commenced in 1847 by Dr. D. D. Owen, United States Geologist, we intended, hereafter, to give a more extended review of the important geological facts and practical results than our space then admitted. This we

now proceed to do in as succinct a manner as the interest of the subject permits, premising with a few remarks on the general appearance of the work.

The text is comprised in a handsome quarto of 638 pages, interspersed with upwards of 140 wood-cuts, 70 of which are geological scenes of particular interest; the rest local sections. They are amongst the best wood-engraving this country has produced, and eminently calculated to convey a vivid impression of the rocky scenes and geological phenomena they are intended to illustrate, and contribute greatly to the interest of the subject.

An Atlas of plates accompanies the text and contains 27 steel-plate engravings of the most characteristic fossils of each of the formations found in the District, from the oldest fossiliferous strata, to the Eocene tertiary, 18 large plates of sections and profiles of heights, nine of which are on steel and nine on stone. Five of the largest sheets of sections have the topography of the principal streams plotted, in connection with the sections, which add greatly to the interest of the geological features, as well as to a correct appreciation of their geographical position. There are also two quarto maps on steel; one showing the position of the Eocene Tertiary Basin of Nebraska; and the other, which is colored to represent the extension of the geological formations under the vast drift deposits of the interior. The geology of the entire region, together with the approximate boundary of the extension of the Iowa coal field through Missouri, is united on a large colored map, 28 inches by 48.

The engravings on steel, representing the organic remains, deserve particular notice for their admirable faithfulness and beauty of execution. We understand that ten of them, viz.: Tab. I, IA, IB, ID, II A, II B, III A, VII, VIII and VIII A, have been executed by a new style of *machine* engraving, similar to that adopted for the representation of medals, and described by Dr. Owen as follows. "The fossil itself serves as a guide and model to work from. After the specimen is fixed permanently on the machine, one arm, pointed with steel, traverses all its inequalities of surface, in close, parallel, waving lines, and imparts a corresponding movement to a diamond point, in contact with the steel plate, which cuts similar lines through the prepared asphaltum surface down and slightly into the steel plate; subsequently these lines are corroded deeper—in the language of the engraver, bitten—into the metal by means of dilute nitric acid. Thus is produced an engraving, in a delicate silvery effect of light and shadow, capable of giving, if desired, 100,000 impressions of as perfect a counterpart of the original as can be accomplished by the daguerreotype process, provided the subject has not *too great relief* and can be placed in a horizontal position in the machine."

"Though the plates in this work are the first application of this art to the representation of fossil remains, it has been a won-

derfully successful experiment which will doubtless be the means of its introduction whenever the form and character of the subject admits of its application. All structure visible to the naked eye can be brought out by this process; and even minuter structure, indistinctly visible to the unassisted eye, can be worked up by a skillful artist, after the plate comes from the machine, as may be seen by inspecting figs. 4, 11, 13 and 20 of Tab. IIB, and figs. 16, 19, and 21 of Tab. IIIA."

The plates engraved from daguerreotypes of the originals are also admirably executed, especially Tab. XII, XIIA, and XIIB. Altogether we have seldom, if ever, seen engravings which present so life-like an effect, if such an expression be admissible, in figures of fossil remains.

The first chapter of the Report embraces a description of the protozoic or most ancient fossiliferous strata belonging to the palæozoic period. The developments in regard to the organic contents of these rocks, in the valley of the Mississippi, are amongst the most important discoveries and contributions of the survey in a scientific point of view.

On this head we extract the following:

"It had been usually believed, up to the date of my Annual Report of 1848, that the lowest members of the sandstone formation of which I am now speaking, were devoid of fossils. The geologists of our own country had set down the Lingula beds of the New York Potsdam Sandstone as the oldest fossiliferous rocks in the United States. And, in Europe, with the exception of the *Obolus Appolinis* of Eichwald, abundantly found in the inferior sandstones of the protozoic strata of Russia, no fossils whatever (according to any established system) had been described or discovered beneath what has been usually regarded as the equivalent of the above-named Lingula beds. I am now able to exhibit a new and interesting geological feature with regard to this formation.

The present survey has brought to light the fact, that in Western America are found strata underlying coarse Lingula grits, and at a depth of seventy-five to one hundred feet beneath them, which are highly fossiliferous, and contain not the *Lingula* and *Obolus* alone, but *Orbiculas*, *Trilobites*, and compressed subconical bodies, resembling some forms of *Cephalopoda*, but probably not actually of that order. The sedimentary stata, in which, on the Mississippi and most of its tributaries, these fossils occur, either rest immediately on the igneous rocks of Wisconsin, or are separated from them by an inconsiderable thickness of chlorite and ferruginous slates; and are, in all probability, the oldest fossil-bearing rocks yet brought to light in any part of this Continent, if not of the world.*

* In the chloritic and ferruginous slates here metioned no organic remains have been discovered. In these rocks I am unable to trace any analogy, in lithological character, to Professor Emmons's "Taconic System." Whatever may occur elsewhere, it does not appear that in the Valley of the Upper Mississippi, any fossil-bearing rocks, deserving the name of a distinct system, occur intervening between the igneous rocks and the base of the sandstones belonging to the Silurian period.

Without assuming to determine the much-disputed question of an absolute *palæozoic base*, it may be safely asserted that the fossiliferous strata above referred to, exhibit the true base of the zoological series in the Mississippi Valley.

It was in August of 1847, while descending the St. Croix, that I first observed multitudes of *Lingulas* and *Orbiculas* disseminated in strata abutting against the protruding trap ranges which cross the stream at its falls. In tracing out the geological position of these strata, during the succeeding months of the same year, I usually found them either, as in the above instance, in almost immediate contact with the trap or granite, or else separated from these only by the lowest member of F. 1. Their depth below the base of the Lower Magnesian Limestone, I found to be not less than five hundred feet.

I observed, also, that besides *Lingulas* and *Orbiculas*, there occurred in the sandstones of this formation, (above the *Lingula* grit, however) other *Brachiopoda* and several forms of *Crinoidea*, found in peculiar green dolomitic interpolations.*

In October of the same year, while measuring sections on the Mississippi, between the Falls of St. Anthony and the mouth of the Wisconsin, I discovered within a few feet of low-water mark, ten miles below Mountain Island, on the west side of the Mississippi, laminated grits and siliceo-calcareous layers, charged with an *Obolus*, probably identical with that occurring in the inferior sandstones of Russia; and from some of the very lowest of these, I collected specimens of a peculiar Trilobite, remarkable on account of the spines with which it is provided, projecting backwards from the margin of the pygidium.

Convinced that the formations of Iowa and Wisconsin were destined to divulge new facts relative to the palæozoic base in Western America, I caused to be instituted, during subsequent surveys in 1848, 1849, and 1850, minute stratigraphical and palæontological sections at every favorable locality. The result showed, beneath the Lower Magnesian Limestone, at least six different Trilobite beds, separated by from 10 to 150 feet of intervening strata.

I communicated this fact, in general terms, in my Preliminary Report of October 11, 1847, and more at large in my Annual Report for 1848, published in the spring of 1849.

The largest species of *Trilobite* obtained in this formation, and which I have named *Dikelocephalus*, is figured on Plate I, fig. 1. It occurs a few feet above the water level on Lake St. Croix, imbedded in a species of hydraulic limestone (the fifth Trilobite bed), near the top of member *d*, of F. 1.

* The analysis of a coarse, buff, crystalline variety of these beds, is as follows:

Moisture,	0·40
Insoluble earthy matter,	2·74
Carbonate of lime,	48·24
Carbonate of magnesia,	42·43
Protoxyd of iron, with a trace alumina,	6·14
Loss,	0·05
	100·00

Many of the fossiliferous beds of this formation are densely crowded with organic relics; as much so as the most fossiliferous of the blue limestones of Ohio, Indiana, and Kentucky. The proportion of genera and species, it is true, is not great, but the number of individuals is immense; some slabs are so covered with shells, that it would be difficult to place the finger on a spot without touching some of them.*

If we except the white sandstone, the uppermost bed of F. 1 *e*, that upon which the Lower Magnesian Limestone (F. 2) rests, nothing definite was known, up to the period of the present survey, of the nature or character of the underlying beds just described; neither had any well-defined organic remains been described anywhere beneath the gray and blue fossiliferous beds which form the upper portion of the sections at Prairie du Chien; so that there was an entire absence of all palæontological evidence as to the exact place which these strata occupied in the Western geological series. It is, therefore, with no small degree of satisfaction that I find myself able to disclose a new feature in the palæontology of Western America, and thus to furnish, not only to the geologist a key to the stratigraphical position of the rocks north of the Wisconsin River, but, at the same time, to the miner his surest and safest guide by which to direct operations in the search after mineral wealth."—pp. 51–52.

The immense extent of the protozoic rocks chiefly belonging to its lower division seems to be a remarkable feature of the geology of the Northwest. The area of the "Lowest Sandstone" where it is fairly exposed cannot be less than 12,000 square miles; and that concealed by drift at least as much more, within the confines of the United states. These sandstones attain a thickness in the best exposed sections on the Mississippi and Wisconsin rivers of upwards of 500 feet. The calcareous beds of the same period are fully as extensive. Commencing on the Mississippi in lat. 41° 30′, they prevail to the Wisconsin and Turkey rivers, and thence capping the above-mentioned sandstones, they stretch, with little interruption, on both sides of the Mississippi, to within a few miles of the Falls of St. Anthony; thence up the valley of the Minnesota river, nearly to its confluence with the Lesueur river; and after being lost under the drift, they reappear at the Great South Bend of Red river of the North, at Lower Fort Garry and Great Lake Winnepeg.

The *upper* magnesian limestone has, in the valley of the Mississippi River, south of Wisconsin and Turkey rivers, a length from north to south of nearly 100 miles, and even a greater width from east to west, giving an area of at least 11,000 square miles. North of Wisconsin and Turkey rivers to the St. Croix valley, the *lower* magnesian limestone has a length from northeast to southwest of 160 miles, with an average width of nearly 50 miles, giving an area of 8000 miles, and this without its extension in the valley of Red River of the north, and under

* See Tab. 1, B. Fig. 1.

the drift. And what is remarkable, these calcareous rocks, throughout this vast range, are, for the most part, highly charged with magnesia, containing from 15 to 20 per cent. of this earth.

These magnesio-calcareous beds, more than any other formation, impress upon the landscape the peculiar picturesque scenery so characteristic of the Upper Mississippi country in Wisconsin and Iowa. They are moreover the lead-bearing rocks of these States, from whence so much mineral wealth has been derived. From the recorded statistics in the table on page 61, it appears that the veins of Galena, worked in the upper magnesian limestone, in the Mineral Point district of Wisconsin and part of the Du Buque district of Iowa, yielded in 1847 upwards of fifty-four millions of pounds of lead, and, as it is justly remarked, this amount would undoubtedly have been much increased up to the present time, but for the inducements offered to miners to emigrate to California.

The whole of these two vast formations—as well siliceous as calcareous—with the exception of the coralline and pentamerus beds, are referred to the lower Silurian period of Murchison. The upper and lower Magnesian limestone formations are separated by a subordinate bed of sandstone, varying from 40 to 100 feet in thickness, often composed of limpid grains of quartz, upon which rest two beds of fossiliferous limestone with a non-fossiliferous band intervening. In all 30 to 40 feet in thickness. Analyses showed the lowest of them to be the purest limestone of the Upper Mississippi country, containing only between six and seven per cent. of magnesia. These layers lie at the base of the upper magnesian limestone formation, and are described as richer in organic remains than any of the overlying or underlying beds. Many of the species are identical with those occurring in the blue limestones of the Ohio Valley and the Trenton limestone of New York.

The 2d chapter is devoted to the formations belonging to the Devonian period, which are confined chiefly to the valley of Cedar River and its tributaries. They consist mostly of pure calcareous rocks which underlie the prairie country between the waters of the Wapsipinicon and the upper two-thirds of the Iowa River; and sustain a most productive and retentive soil, well adapted for wheat and small grain. The land is gently rolling and affords every facility to the farmer for the introduction of labor-saving machinery in his sowing and harvest operations, even at the first opening of a farm; since the ground is never incumbered with stumps, which form a serious obstruction in the newly cleared forest lands of Ohio and Indiana.

The lower beds of this formation appear, from the specific character of the organic remains, to correspond in age to the Onondaga limestone of New York; the upper to the Hamilton Group.

The carboniferous rocks which form the subject of the 3d chapter, lie southwest of the above formation, occupying nearly the whole of the remaining portion of Southern Iowa, and extend from the Mississippi across to the Missouri.

The coal-measures, without the circumscribing belt of carboniferous limestone, occupy in Iowa alone 25,000 square miles, extending no less than 200 miles in a direct line up the Des Moines, which river flows diagonally through the heart of that portion of the coal-field which is situated in Iowa. The same coal-field stretches into Missouri, in which state it has at least as great an area.

The coal measures are underlaid by a great zone of sub-carboniferous limestone, the average width of which may be 20 to 25 miles, except in the extreme northeast, where the sandstones of the coal formation abut immediately on the limestone of Cedar Valley.

The sub-carboniferous limestone is described as having a greater thickness than the coal-measures proper, which are only some 300 feet, while the underlying limestones are at least 400 to 500 feet in Iowa, and much thicker farther south in Missouri.

The coal is mostly of the slaty varieties of bituminous coal; the beds varying from a few inches to 4½ or 5 feet. They are included in the shaly argillaceous division of the lower third of the formation. There are beds of greater thickness farther south in Missouri, at the southern margin of the same coal-field.

Under the head of "Physical and Agricultural character" of the carboniferous rocks of Iowa, the author makes the following remarks:

"The carboniferous rocks of Iowa occupy a region of country, which, taken as a whole, is one of the most fertile in the United States. No country can present to the farmer greater facilities for subduing in a short time wild land. Its rich black soil, scarcely less productive than that of the Cedar Valley, returns him reward for his labor a hundredfold. The only drawback to its productiveness is that, on some of the higher grounds, the soil, partaking of the mixed character common to drift soils, is occasionally gravelly; and that here and there, where the upper members of the coal-measures prevail, it becomes somewhat too siliceous.

The rural beauty of this portion of Iowa can hardly be surpasssd. Undulating prairies, interspersed with open groves of timber, and watered with pebbly or rocky-bedded streams, pure and transparent; hills, of moderate height and gentle slope; here and there, especially towards the heads of the streams, small lakes, as clear as the rivers, some skirted with timber, some with banks formed by the greensward of the open prairie;—these are the ordinary features of the pastoral landscape.

For centuries, the successive natural crops of grass, untouched by the scythe, and but very partially kept down by the pasturage of buffalo and other herbivorous animals, have accumulated organic matter on

the surface soil to such an extent, that a long succession, even of exhausting crops, will not materially impoverish the land. The prairie-sod, matted and deep-rooted, usually requires from six to eight yoke of oxen effectually to break it up.

The future farms of Iowa, large, level, and unbroken by stump or other obstruction, will afford an excellent field for the introduction of mowing and reaping machines, and other improved implements calculated to save the labour of the husbandman; and which, in new countries reclaimed from the forest, can scarcely be employed until the first generation shall have passed away.—pp. 100, 101.

The immediate basin of Lake Superior is formed of red sandstones and argillaceous beds, conglomerates and shales overlaid and concealed to a great extent by superficial deposits of red clay, marls and drift; and intersected especially on the northwest shore by a multitude of igneous outbursts which have modified altered and indurated the adjacent strata, and tilted them locally in different directions from the prevalent gentle southeasterly dip. The mechanical action and metamorphism which have resulted, have produced the amygdaloids and conglomerates which usually intervene between the red sandstones and dykes of trap.

The detailed descriptions of these interesting formations are given chiefly in the reports of Dr. J. G. Norwood, and those of Col. Whittlesey; the field of operation of the former gentleman having been principally in middle, northern, and northeastern Minnesota, that of the latter, along the southern watershed of Lake Superior, situated between the Michigan line and the Bois Brulé River.

The 4th chapter contains some additional details regarding the other portions of the interior of Wisconsin, Minnesota and the valley of Red River of the north, for which we must refer our readers to the work itself.

The crystalline rocks and metamorphic schists first appear on the surface about lat. 44° 20′, and occupy, under the superficial deposits, a considerable area in the northern and eastern portion of the district, both N. W. and S. E. of Lake Superior; but the actual surface exposures are limited, inasmuch as the drift deposits have filled up most of the inequalities of the surface, and thus conceal to a great extent the hypogene rocks and crystalline schists, and, at the same time produce a uniformity and levelness of surface which would hardly be anticipated on approaching the sources of such important streams as the tributaries that give origin to the mighty Mississippi. Even the igneous rocks, forming the summit levels, 500 to 1000 feet high, dividing the waters flowing into Lake Superior, and those running into the Mississippi, are, for the greater part of their range, buried beneath heavy drift deposits. The country around the sources of the Wisconsin, Chippewa, St. Croix, St. Louis and Mississippi are described as of this character.

The 5th chapter contains a discussion on the age of the red sandstones of Lake Superior, and the evidence from which it is inferred, with great probability, that its *general dip* is southeast, bringing it underneath the Lingula, Orbicula, and Obolus beds of the St. Croix Valley, and that they therefore constitute the strata intervening between these beds and the crystalline schists that repose on the granite.

The incidental observations in the Eocene Tertiary basin of the Mauvaises Terres or Bad Lands of Nebraska and the adjacent cretaceous deposits, are recorded in the 6th chapter from which we have already given extracts in our March number.

The extraordinary fossil mammalia collected during the survey in this region, were submitted for description to the able comparative anatomist, Dr. Joseph Leidy of Philadelphia, whose Report on this branch of the palæontology, will be found commencing on page 539 of the volume.

Dr. B. F. Shumard's report comprises the details of his observations among the protozoic rocks of the Minnesota Valley, and minute stratigraphical and palæontological details of the most interesting sections on both sides of the Mississippi River, from the falls of St. Anthony to the confines of the carboniferous rocks, near Wyoming, as well as on the Wisconsin River, between its mouth and the igneous exposures on Whitney's Rapids.

The Appendix to the report contains the description of new fossil species and genera, collected during the survey from the protozoic rocks, the limestones of Cedar Valley, the carboniferous rocks and the cretaceous deposits, followed by a systematic catalogue of plants collected by Dr. C. C. Parry, in connection with the geological survey, made during the season of 1848; also a systematic catalogue of birds observed by Mr. Pratten, in the northern part of Wisconsin and southern portion of Minnesota. There are also appended tables of the stratigraphical and geographical distribution of fossil of the northwest and the equivalency of strata.

The thanks of the community at large, and especially of the scientific public, are due to Dr. Owen, for his exertions towards presenting the final results of his labors, and those of the other scientific gentlemen who aided him in the undertaking, in so attractive and appropriate a form; having spent, as we learn, the whole of the winter of '51 and '52 at the seat of government, solely with a view of obtaining the sanction of Congress to have this work printed by *special contract* in Philadelphia, under the immediate supervision of the author, and in the style and form he regarded as most suitable for the subject; by which he has been enabled to produce a work creditable to the government under whose auspices the survey was conducted, as well as to all concerned in it; it stands out in strong contrast with

ordinary public printing, which we are sorry to say has, until lately, been very inferior in its typographical execution and quality of paper. And we hope that Dr. Owen's report, as to style of execution, may serve as a standard for all future Congress documents, which embody valuable practical and scientific information for the people; the more especially since the cost per volume, considering the amount of matter and illustration, has actually been much less than had previously been paid for illustrated scientific works got up at the seat of government in the ordinary unworkmanlike —we may almost say careless and slovenly—manner of most public printing.

ART. XIII.—*On the supposed new element, Thalia;* by Prof. J. LAWRENCE SMITH.

ABOUT fourteen months ago the discovery of a new earth was announced by Dr. D. D. Owen, as existing in a saponaceous mineral from the amygdaloidal traps of the north shore of Lake Superior. A few months after the first announcement, I obtained two or three grammes of the mineral from Dr. Owen, and subjected it to analysis without discovering any substance in it that could be called a new element. The results were not made public at the time, as more material was required to arrive at a positive conclusion. It is only lately that, through the kindness of Dr. Genth of Philadelphia, an additional quantity of the Thalite has been obtained, as well as some of the earth called thalia. Both have been examined with great care: the analysis of the former accords with my former analysis, making the Thalite to be *saponite;*—details of the analyses will be given in the third paper on the reëxamination of American minerals. The earth sent as thalia, is *magnesia* mixed with a little lime.

It may be well to state here, that the fact of the precipitation of the neutral solution of the earth by oxalate of ammonia seems to have had considerable weight on the original decision concerning this substance. But it is an erroneous impression that oxalate of ammonia will not precipitate the neutral and even slightly acid solution of magnesia salts, more or less promptly, according to circumstances, a fact not sufficiently insisted on by writers on analytical chemistry; some experiments on this subject will furnish matter for a future article in which it will be shown that precautions are frequently required to separate lime from magnesia by oxalate of lime, when the magnesia is present in considerable quantity. Further remarks on this substance will be made when the analysis of Thalite is given.

Art. XIV.—*On the Isomorphism of Sphene and Euclase;* by James D. Dana.

It is the more common course, in deducing the fundamental form from the crystals of a species, to consider the two directions of most distinct prismatic cleavage, where such exist, as corresponding to the lateral faces of the fundamental prism. The planes *r*, *r*, in Sphene (see the figures in different Mineralogical Treatises) are of this kind; and taking for the base of the prism *r r*, the plane *y*, (a face of composition in twins and therefore of prominent importance,) the relations of the planes in the crystals of sphene become quite simple.

We here give a table presenting the observed planes in accordance with this view. *O* is the basal plane; and below it are the different vertical series. The planes 1, 2, −2, −1, belong to the fundamental series; 1*i*, *ii*, are in the series parallel to the orthodiagonal; 4*i*, *ii*, in that parallel to the clinodiagonal: and intermediate are forms of the series, *m*2, *m*3, *m*$\breve{3}$, 12 and 22 being of the first, *i*3 of the second, and 6$\breve{3}$ and −3$\breve{3}$ of the third.*

			$O(y)$		
$1i(x)$	$12(w)$		$1(z)$		
	$22(e)$		$2(n)$		
					$4i(s)$
				$6\breve{3}(u)$	
$ii(P)$		$i3(o)$	$I(r)$		$ii(b)$
					$4i(s)$
				$-3\breve{3}(m)$	
			$-2(t)$		
			$-1(l)$		

The table represents a quarter section of the crystal, and is somewhat analogous to a Mercator's projection of it. The fundamental vertical series is marked off by placing it between heavier lines in the table, and so also the horizontal series of vertical prismatic planes. For the convenience of comparison, we have also given the lettering adopted by others.

* The expressions, as in Naumann's symbols, represent the parameters of the planes, the first figure (or letter) referring to the vertical axis, and the second indicating the ratio between the two lateral axes. In the expression 1 2, the figure 2 means that in the parameters of the planes there is a ratio of *twice* the orthodiagonal to *once* the clinodiagonal; and in 6 3, the $\breve{3}$ indicates a ratio of 3 *times* the clinodiagonal to *once* the orthodiagonal; in the former, the 1 signifies *once* the vertical axis, and in the latter, 6 signifies 6 *times* the same axis. In the planes 1 and 2, the second figure is not expressed, a unit being understood, the ratio between the lateral axes being that of unity; the planes are of the fundamental series. The letter *i* is written in place of the symbol for infinity (∞), and hence *i* 3, signifies that the plane is parallel to the vertical axis, and has the ratio between the orthodiagonal and clinodiagonal of 3 : 1; *ii* is parallel to the vertical axis and orthodiagonal; $\breve{i}\breve{i}$ is parallel to the vertical axis and clinodiagonal; $\breve{i}$ (or *I*) is parallel to the vertical axis, and has the ratio 1 : 1 between the orthodiagonal and clinodiagonal, or in other words, it belongs to the fundamental series and is the vertical prism of that series; 1*i* is parallel to the orthodiagonal, and the 1 shows its relation to the vertical axis and orthodiagonal; 4*i* is parallel to the clinodiagonal, and 4 refers to the vertical axis.

The crystals of sphene from northern New York, called Lederite by Shepard, present actually the fundamental form here adopted, with simply a plane on each basal edge (2 or n and -2 or t), and a truncating plane (ii or P) on the front lateral edge.

The inclination of the vertical axis is 119° 33′; and making a the vertical axis and b the clinodiagonal, $a:b:c = 0{\cdot}4277:0{\cdot}75414:1$. The interfacial angle $I:I(r:r) = 113°\ 28'$, $O:1i(y:x) = 158°\ 55'$, $1:1(z) = 149°\ 38'$, $2:2(n) = 136°\ 4'$.

This mode of viewing the crystallization of sphene brings to light an approximate isomorphism of the mineral with Euclase. In euclase $I:I = 114°\ 50'$, $O:1i = 158°\ 10'$, $1:1 = 151°\ 48'$. The principal difference in the dimensions of the two is found in the greater length and inclination of the vertical axis in sphene, this inclination being in euclase but 108° 53′. Euclase has also a perfect clinodiagonal cleavage.

In chemical composition, the species are widely different, sphene being a titano-silicate of lime ($\dot{2}\dot{C}a\,\ddot{S}i + \dot{C}a\,\dddot{T}i^3$), and euclase a silicate of alumina and glucina ($\ddot{\dot{A}}l^{\frac{1}{2}} + \ddot{\dot{B}}e^{\frac{1}{2}})^4\,\ddot{S}i^3$.

Art. XV.—*Characters of* Tetraclea, *a new genus of Verbenaceæ;* by Asa Gray, M.D.

The plant which forms the subject of this article first came to my notice in the Texano-New Mexican collection made by the indefatigable Mr. Charles Wright, in the year 1849. In the same or the preceding year, it was likewise collected by the late Dr. J. Gregg, in the Northern part of Mexico. Fine specimens also were gathered by Mr. Wright on his second journey, while attached to the scientific corps of the Boundary Commission. In 1851, while under the command of Col. Graham, he collected it on the northern border of the Mexican state of Sonora; in 1852, while returning under the orders of Major Emory, he again met with it in the western part of Texas. I presume it has likewise been found by Dr. C. C. Parry, and Dr. J. M. Bigelow, during the survey of the Rio Grande from El Paso downwards; but I have seen no specimens from them. Specimens are in both of Mr. Wright's distributed collections. I have, moreover, just detected it in the late Dr. Coulter's Mexican collection, whose name, as being the first discoverer, the species may appropriately bear. The natural order to which the plant in question belongs is not very evident at first view. In Mr. Wright's notes, made at the time of gathering it, the plant is mentioned as a doubtful *Borraginacea;*—a view suggested by the deeply four-lobed fruit, and the nearly regular, pentamerous calyx and corolla. But the leaves

are opposite, and the stamens are only four in number. The latter characters, along with the quadrinuculate fruit, and the axillary cymulose inflorescence, would incline us to refer the plant to the order *Labiatæ;* which again is forbidden by the regular corolla, the apparently equal stamens, and the amphitropous descending ovule. The latter character points to the true affinity of the genus, which unquestionably should be placed in the Viticeous division of the order *Verbenaceæ;* notwithstanding the deeply four-lobed ovary, and the fruit of four nucules. This remarkable character may well furnish the name of the genus;—which I accordingly form of τέτρα, four, and κλείω, to close or shut up, referring ro the four closed nutlets of the fruit.

TETRACLEA, Nov. Gen.

Calyx profunde quinquefidus, tubo turbinato, lobis subæqualibus. Corolla hypocraterimorpha, tubo calyce longiore, limbo quinquepartito, lobis obovatis fere æqualibus. Stamina 4, fauci corollæ inserta: filamenta filiformia, æquilonga, exserta, in alabastro involuta: antheræ ovales, loculis parallelis. Ovarium profunde quadrilobum: stylus filiformis apice bifidus: stigmata subulata. Ovula in loculis solitaria, amphitropa, pendula; micropyle infera. Fructus quadrinuculatus, calyce persistente immutato cinctus; nuculis siccis obovatis reticulatis crustaceis. Semen loculo conforme, subcurvatum, supra medium appensum, exalbuminosum. Embryo leviter incurvum; cotyledonibus ovalibus crassiusculis; radicula brevi infera.—Herba erecta, humilis, e basi suffrutescente; foliis oppositis petiolatis ovatis subdentatis; floribus in axillis cymulosis sæpius ternis majusculis; corolla alba post anthesin flavescente.

Tetraclea Coulteri.—Mexico, *Dr. Coulter* (No. 1172, in coll.).—Prairies of San Felipe and Live Oak Creeks, Texas, *Wright*, 1849 (No. 462); also at Escondido Springs, in the same district, 1852. Azufrora, near Saltillo, Mexico, *Dr. Gregg* (No. 502). Saur de Cieñega, between Conde's Camp and the Chiricahui Mountains, on the borders of New Mexico and Sonora, *Wright*, 1851 (No. 1513).

The other Verbenaceous plants of Mr. Wright's collection which appear to be new are *Bouchea linifolia*, sp. nov. (No. 449 and 1509), and *Lippia* (*Aloysia*) *Wrightii* (No. 1506)), a species allied to L. scorodonioides.

SCIENTIFIC INTELLIGENCE.

I. Correspondence.

Correspondence of M. J. Nicklès, dated March, 1853.—Continued.

Those who have experimented on electric light have remarked the fact, that the current is not established until the two points of charcoal have been brought in contact. It may be made to pass, however, by sending an electric spark from a Leyden jar between the charcoal points, an experiment attributed by Sturgeon to Herschell (Annals of Electr., viii, 507). In both cases evidently the current is produced by causing a passage from one pole to the other of material particles.

M. Masson inferred from his early researches that the electricity of induction will not traverse the barometric vacuum, and that the presence of ponderable matter is necessary to its propagation. But on the other side, M. Quet and M. Despretz establish in different ways by precise experiments that the vacuum is not only a conductor of currents of induction, but also gives free passage to the direct current of the pile. M. Masson has since renewed his researches and has recognized the fact, that the vacuum is a conductor of induced electricity. And to this, he adds another, that two currents of induction may traverse the same wire going in opposite directions without mutual interference.

M. Quet experimented with Ruhmkorff's apparatus.* By interposing a galvanometer he observed that there was no deviation as long as the vacuum was not sufficiently advanced; but as soon as the successive discharges produced an appearance of continued light, the needle of the galvanometer deviated and afforded evidence of an electric current. The deviation increased as the rarefaction was made more perfect, and also as the balls terminating the poles were approached. This observation was made with the aid of the receiver called the *electric egg*. The very long spark thus produced in the vacuum, consisted of two kinds of light quite different in color, form, and position; one of a violet color surrounded the negative ball; the other, of a fiery red adhered to one side of the positive ball, and extended from the other to the negative ball, having for its limits laterally a surface of revolution around the axis of the receiver.

M. Quet has found that this double light is made up of a series of brilliant layers entirely separated from one another by dark layers, presenting thus a species of stratification. The structure was further shown by producing the vacuum in an atmosphere of the vapors either of wood spirit, essence of turpentine, alcohol, oil of naphtha, sulphuret of carbon, bichlorid of tin, fluorid of silicium, etc.; numerous brilliant layers were thus formed separated by dark layers, forming as it were a pile of electric light between the two poles of the receiver.

The nature of the vacuum influences more or less the colors of the two lights in this phenomenon of stratification. When the vacuum is made over fluorid of silicium, the negative light is yellow; when over essence of turpentine in glass tubes, the positive pole is covered with

* This Journal, [2] xv, 114.

long columns of fine white light and phosphorescent, in which the layers of the stratification are sensibly plane and of unequal thickness. In most of the vacuums the two lights are separated by a dark layer. On approximating to one another, the two balls, when the vacuum has been made in atmospheric air, the red light disappears completely whilst the violet brightens. In the vacuum made over the fluorid of silicium, the contrary is true; the light of the positive pole disappears, and the negative yellow light becomes very brilliant, as well as the purple rings which surround it. These rings are developed on the contrary about the positive pole when the two balls are much approximated.

These singular phenomena observed by MM. Ruhmkorff and Quet by using an interrupted current from a single Bunsen element with Ruhmkorff's apparatus, have also been observed by M. Despretz in the luminous arc produced by a continued current from an energetic battery; it is true, however, that M. Despretz has not analyzed the phenomenon as minutely as the two physicists before mentioned. M. Despretz has observed that in a vacuum nearly perfect, the spark of the pile may increase in brilliancy, and the arc may be formed and maintained at a distance of one and even five centimeters, not only with charcoal points but even with the metals. The distance at which the spark appears increases with the number of the elements.

Glycerine.—Glycerine is one of those substances produced abundantly in soap and candle making which was for a long time wasted, it being of no known utility. A method was patented some time since for protecting with it the zinc of a galvanic circuit, so as to do away with the necessity of amalgamation; but I have repeated the experiments with care without success, and other chemists have not been more fortunate with it.

A use of it of real importance has been more recently introduced. It is known that the clay for foundries dries rapidly, and requires hence a series of precautions on the part of the moulder, which are not always successful. To avoid these embarrassments, M. Barreswill kneads the clay with a concentrated solution of glycerine; and thus prepared, it retains its moisture and consistence as required.

These facts are called to mind by the appearance of a memoir of a purely theoretical character which M. Balard has presented to the Academy of Sciences in the name of its author, M. Berthelot, his assistant at the "College de France." As scientific labors usually precede the applications, we cannot multiply too much such researches as those of M. Berthelot or those which have been for some time occupying M. Redtenbacher.

M. Berthelot has generalized the important fact brought out by MM. Pelouze and Gelis—that is, that glycerine will combine with butyric acid and form *butyrine*, the proximate principle of butter. He has prepared *acetine*, which is probably the proximate principle of cod-liver oil; *valerine* which M. Chevreul extracted from whale oil and called phocenine; also *benzoicine* and *sebine*, which are examples of neutral compounds with a bibasic acid, the *sebacic*, and glycerine; and finally, M. Berthelot is in the way of preparing directly *stearine* and *margarine*.

This process is in general that of Pelouze and Gélis. The dry acid is put with the syrupy glycerine and heated to 100° C.; then a current of chlorohydric acid is passed for some hours, keeping the mixture at 100° C., and allowing it to cool in the current of gas. This done, the whole is left at the ordinary temperature, and the chlorohydric acid is applied again, as may be needed. After more or less time the combination is produced; and to isolate it, it is only necessary to saturate the mixture with carbonate of soda.

Quinidine.—As supplemental to our former article on Quinidine, we will say that M. Pasteur has explained the contradictions of the different results that have been published respecting this alcaloid. Quinidine is a mixture of two distinct alcaloids, differing in crystallization, solubility and rotatory powers; one is anhydrous, the other hydrous. The alcaloid which more resembles quinine, is optically the reverse of that base, it causing polarized light to deviate to the right.

Racemic acid.—M. Pasteur has presented through M. Biot, a notice of the source of racemic acid. We have reported in the January No. of this Journal some of the curious observations which M. Pasteur has made with this acid. It was in consequence of those observations that by the suggestion of M. Biot, the Academy requested this chemist to continue his researches at their expense. There has been a prompt reply, and we now know from M. Kestner and M. Pasteur, that racemic acid is a natural product, occurring in almost all the tartars; it is not an accidental result in manufacture, as believed by some chemists, or a product peculiar to the grapes of the Vosges, a supposition that arose from the position of M. Kestner's establishment, and which originated the name *vosgic* acid, changed to *thannic acid* by Gay-Lussac from Thann, a manufacturing village of the Upper Rhine, where are M. Kestner's works, in which this acid was discovered.

The process for racemic acid having been considered a secret of M. Kestner's, he was enquired of by M. Pelouze with regard to it, when this celebrated manufacturer mentioned the process he followed in 1820 when the discovery was made, and added that he had not been able since to obtain it. Hearing that an English manufacturer, Mr. White, had obtained racemic acid from the crude tartar of Naples, Sicily and Oporto, M. Kestner remembered that towards 1820 he had received part of his crude tartar from Italy. He had intended to take up the subject systematically; but being first kept at Paris as representative of the people, and soon afterwards exiled for the crime of republicanism, he was compelled to suspend his useful labors.

In this state of the subject, the Society of Pharmacy of Paris in 1851 proposed the two questions: Do these crude tartars contain racemic acid ready formed? Under what circumstances is tartaric acid transformed into racemic?

Soon after, M. Pereira reported that racemic acid was common in English commerce. But this was an exaggeration; the only vender in London, Mr. Simpson, received it from Germany. M. Pasteur hearing through M. Mitscherlich that it was made at a Saxon manufactory, visited the place but found little of the acid; the tartar had been received from Trieste. He was more successful at Vienna, where, guided by Prof. Redtenbacher, he detected it in the crude tartars of Austrian commerce. Those of Naples, Hungary and Styria also contained it.

After these developments by M. Pasteur, M. Kestner, with whom expense was nothing in this question, imported some crude tartar from Tuscany, and immediately obtained from it racemic acid; at the same time, M. Seybel at Vienna obtained considerable proportions of racemic acid.

To extract the acid from tartars which contain it, it is only requisite to operate on the mother liquor which has been a long time in use and to treat the residues as crude tartars.

M. Pasteur finds that the racemic acid from all the manufactories occurs in needles implanted on large crystals of tartaric acid; and at Vienna they were so abundant as to depreciate the value of the latter acid in commerce, which was considered impure.

M. Pasteur considers the transformation of tartaric acid into racemic as utopian. More ample details will be found in the Comptes Rendus of the Academy of the 3d of January, 1853.

Metacetic acid.—At a subsequent session of the Academy, attention was directed to a congener of racemic acid—the citric acid, for which M. Pasteur had done what I had myself proposed to do in 1846 and which I had moreover executed as regards tartaric acid.*

M. Noellner on examining a volatile acid accidentally produced in a manufacture of tartaric acid under his direction at Freudenstadt (Wurtemberg), thought he recognized a peculiar acid which Berzelius pronounced to be only a mixture of butyric and acetic acids. In 1846 Liebig sent me two specimens of this acid: one I found to be a mixture of acetic and butyric acids, the other contained a peculiar acid which was volatile at 140° C., produced a barytic salt crystallizing in oblique rhomboidal prisms, and which had a composition corresponding to the formula $C^6H^6O^4$, the formula of metacetic acid. M. Dumas on comparing my acid, which I called the *butyro-acetic*, with the metacetic, which he had just obtained by means of cyanhydric ether (Comptes Rendus, 1847), thought he had established their identity. In my view this identity was not proved. It is probably a case of isomerism like that of propylammine and triethylammine.

Whatever the fact, this acid was produced by M. Noellner at the expense of tartaric acid, while this chemist was drying a large quantity of tartrate of lime, an accident known to the manufacturers. It is then a product of fermentation, like that of butyric acid from lactic acid through the lactate of lime, of succinic acid through malate of lime. Time does not permit me now to operate upon the congeners of tartaric acid, and M. Personne has undertaken it,—a work important to the manufacturers of citric acid, who have been aware for a long time of the difficulty of preserving citrate of lime without alteration. On causing a large quantity of crude citrate of lime to ferment, M. Personne obtained acetic, butyric, and carbonic acids, and hydrogen. He considers the following as the reactions—

$$4(C^{12}H^{3}O^{11}+4HO)=3(C^{4}H^{4}O^{4})+2(C^{8}H^{8}O^{4})+20CO^{2}+8H,$$

and he thinks that the constant presence of hydrogen indicates the formation of lactic acid, and that this is the source of the butyric acid which is produced during this fermentation.

* Sur un acide particulier, resultant du tartre brut sous l'influence de la chaux et des ferments, par M. J. Nicklès, Revue Scient., Dec., 1846.

Correspondence of M. Jerome Nicklès, dated April 27, 1853.

Auguste Laurent.—The sad event for some time anticipated, has taken place. On the 15th of last April at half-past 8 o'clock, science lost one of her most illustrious representatives in the person of Auguste Laurent. His short life so well employed, was spent in his family and his laboratory. It was a life of contest with circumstances, and hence instructive to the moralist and philosopher; it was also, I fear not to say it, one of encouragement to the earnest worker who puts principles before persons and prefers the straight path to intrigue. If ever a man elevated himself by the force of genius and perseverance, such preëminently was Laurent, to whom everything was denied, and who made his chef-d'œuvre out of nothing. Laurent was one of those men who must die before they can be fully appreciated; I well know that he will receive his due only when impartial history shall be substituted for self-love and party spirit. It will then be acknowledged that during the short space of time in which he appeared above the scientific horizon, the ideas that he brought forward were successively confirmed, after the announcement of his fundamental principle which he thus expresses:—that *Form or arrangement has often more influence on properties than matter itself*—a principle which served as the guiding thread in his researches, even to the theories of *substitution*, of *hemimorphism*, of *isomeromorphism*, and of *crystalline types*, these in fact being corallaries from this principle.

Few chemists have understood Laurent; and if we except Mr. T. S. Hunt of Montreal, Messrs. Williamson and Hofmann of London, M. Strecker, MM. Gerhardt, Chancel, Bessaignes and some others, and finally the learned and venerable Leopold Gmelin of Heidelberg, the rest generally end with admiring the fertility of this extraordinary man and the great number of new compounds which, with means the most simple, he has discovered, isolated, studied and analyzed.

I do not pretend to write his biography. I feel neither worthy nor capable, and find myself too much under the influence of grief to trace out coldly biographical details. But what I may affirm, after having attended upon his last moments, is that his death was worthy of a life so pure; not a word of blame for those who had wronged him, but expressions of deep regret at his unfinished work and his limited means for executing his labors. His love of science came out in his delirium, and in his hallucinations he believed himself in his laboratory.

Foreseeing his death as near, his friends, with different pretexts, urged that he should give an exposition of his views, such a one in fact as was asked of him by M. Liebig nine years before, when Laurent, while at Giessen, gave by request of the chemists of the laboratory, an extempore discourse on his theories in the lecture-room of the school. Liebig offered him at that time an entire number of his Annalen for the publication of a review of his labors and of the ideas which had guided him in his researches; and three of the students offered also to translate the work into German, English and Italian. This project is now in part to be realized; the manuscript, which I have in my hands will soon be put to press, and I believe that I may announce to the scientific public that before six weeks from this—now the 20th

of April, this last work of M. Laurent will be printed and published,—even with its imperfections, for no changes will be allowed; even the punctuation throughout will be respected, although he considered it susceptible of modification and proposed to undertake it.

Laurent was elected a corresponding member of the Academy of Sciences in place of M. Faraday, who had become Foreign Associate: time was not allowed him to be made a privileged member: he died nearly at the age of Scheele and Lavoisier, at 46 years.

In 1828 Laurent was student in the Ecole des Mines, and he there made his first essays in science, by his researches on the treatment of ores of cobalt, arsenic, &c., and his experiments on the fabrication of smalt, etc. Being then named to the modest place of chemist to the manufactory of porcelain at Sèvres, at that time directed by Alex. Brongniart, he made his researches on the cementation of steel; he demonstrated (1837) the volatility of carbon at high temperatures; he studied the products of distillation of the oils of bituminous schist; he proposed the use of paraffine and of different carbo-hydrogens of this oil for lighting; and he finally threw himself into organic chemistry, which he pursued in a manner the most brilliant while with means so narrow.

Too generous, too disinterested to be capable of drawing any pecuniary benefit from his discoveries, he cast them into the public domain, wherever occasions presented, and thus gave fortunes to others. It was only after the revolution of February that justice commenced to favor him. In a country where all is done by the government, it was the part of a republican government to occupy itself with the welfare of one of its most illustrious citizens. On the 14th of May, 1848, Laurent was named assayer at the Mint. This was the commencement of reparation. The Republic did not continue, so as to make the reparation complete, and Laurent died without having realized his favorite idea of having at his disposal one of the numerous laboratories of Paris where he might work without keeping an account with his purse.

Auguste Laurent leaves a widow and two young children, and friends who deplore him with much tenderness: to the former he bequeathed the glory of his illustrious reputation, to the latter, his example; to all a model of self-denial, of devotedness, and of sacrifices.

Repeopling of Streams with fishes, or Pisciculture.—In my last communication I mentioned briefly the experiments of M. Millet on the reproduction of fishes. I have said that, thanks to the modest fisherman of the Vosges, Rémy, fish is now in fact a manufacture in France,—a fact most valuable to our old Europe, which has hardly the means of sustaining its inhabitants, and whose streams have been depopulated of the good kinds of fish, the spawn having been destroyed by manufactories along the water courses, by steamboats, drainage-works and inundations.

A paper by M. Haxo, secretary to the Société d'Emulation des Vosges, gives the history of this important invention, and reviews the means employed by Rémy for populating with trout the streams of his neighborhood. This fisherman observed the time when the female deposited its eggs; he remarked that the male then comes and spreads over it the fecundating liquid; and as our observer could but imperfectly

protect these eggs from the various chances of destruction, he learned how to imitate nature, by promoting the parturition of the female, and then that of the male, and placing the eggs in the conditions most favorable for their development; he had thus the happiness of seeing the breeding of a certain number of trout, and noticed their preserving under the venter a part of their eggs, and living during some time at the expense of the rest.

But this was not all: it was necessary to provide for the ulterior preservation of the young animal by a practicable process. The obscure fisherman, who hardly knew how to read, did not yield before this difficulty: he set at work observing again; he placed some frogs in the basin containing the young trout, judging with reason that the spawn of these batrachians would be a resource for the spawn of the trout; he gave them also bits of veal as they grew larger. But as these aliments, though successful, would be too expensive, Rémy, not knowing of the existence of the sciences of botany and chemistry, contrived a process based on one of the great laws of nature. He planted some herbivorous fishes in the water which contained the carnivorous trouts, and from this moment he had no more trouble with the raising of his "élèves." In the course of six years, with very limited means, Rémy, who was in the interval associated with Géhin, had bred several millions of salmon and trout. After he had been for six years thus preparing the living food for his fishes, M. Haxo, made known his results to the Academy of Sciences, and the government ordered a full investigation into Rémy's process. Pisciculture was established in the basins of the canal of the Rhone, on the Rhine at Luningue, in the department of the Upper Rhine, not under the direction of Rémy or of Géhin, but of M. Coste, who had succeeded in appropriating to his own profit the labors of the modest fisherman. A spirited dispute ensued, which continues still, and has engaged several independent pens, as MM. Haxo, Victor Meunier, the journal "La Presse," the Abbé Moigno, etc., who defended the rights of the oppressed against the despoiler. Justice will be done; Rémy will receive a pension as a national recompense.

I pass in silence the reclamations of priority, and the attacks of all kinds which have accompanied the success of Rémy. My last communication on hot air engines, has shewn how such facts are rapidly produced whenever there is success.

The following is briefly the method employed in this new branch of industry. Through M. Millet, Inspector of forests, the processes are become so simple that they can be executed by the most inexperienced hands. The Administration of the waters and forests, is now organizing a regular service for effecting a repeopling of the waters of navigable streams. The apparatus of M. Millet is placed in the hands of the fish-keepers, and the living alimentary material will be manufactured so to speak, at all points. The details which follow are taken from a work yet unpublished on Millet's process, which I have seen in the course of its preparation.

Two boxes of lead, 1 meter long and 1 to 2 decimeters broad, and 5 to 6 centimeters deep, are disposed in steps in the fire-place of his apartments. Some frames or sieves of hair, flags or metallic network,

etc., contain the eggs. According to the species, these eggs are immersed to a depth of one or several centimeters. These frames may be withdrawn or replaced at will, by means of tringles which support them by pressing against the side of the box. A reservoir of water, furnished with charcoal and gravel is near by and turns into the box, drop by drop, filtered water, furnishing about 2 or 3 litres of water per hour. The water is thus always in motion, and it is only necessary to fill the reservoir each morning to keep the apparatus in action without supervision.

The total expense of the establishment is but 6 francs. With 35 litres of water for six weeks, M. Millet has bred about 25000 trout or salmon, and he expects to breed some millions of different species in the course of the year.

In order to obtain the eggs from the female, M. Millet employs nearly the process used by Rémy and Géhin. He makes the eggs to pass out only as they are mature, leaving an interval of two days between each operation, this consisting in passing the finger lightly over the surface of the abdomen of the female. Another process consists in enclosing the female in a cage with a double bottom, formed of bars rather far apart; the females drop their eggs by organic contraction, and aid themselves in it by rubbing against the bars. The eggs fall upon the frame. The males are then introduced, and often they fecundate at once the eggs, being incited to it by the presence of the female and the odor of the eggs; but if not so, it is provoked by slight friction as in the ejection of the eggs from the female.

Another result of interest is that M. Millet has caused trout and like species which live in running streams, to breed in standing waters, by causing some aquatic plants to grow in the water. The species which I have seen employed, was the *Lemna minor* (duck weed).

This experiment calls to mind the *organic equilibrium* of Mr. Warrington. It is known that this chemist has for several years kept in a glass vase full of water, a small aquatic menagerie, consisting of a *Valisneria spiralis*, several fish (species of Gasterosteus), and some aquatic univalves, without injuring the purity of the water. It is seen that the carbonic acid and azotized products given out by the animals are absorbed by the plant, which converts at the same time the carbonic acid into oxygen. The debris of the plant serves as nutriment to the snails whose eggs in their turn feed the fish.

The process of M. Millet has been put in practice in several places near Paris, and repeopling the rivers has been already begun. Contrary to the prescription of Rémy and Géhin, who nourished the young for some time on the spawn of frogs and coagulated blood, after the pouch under the venter had disappeared, M. Millet commences the distribution of them whenever this period has arrived. The future will show whether the method just mentioned is wise, or whether it will not be necessary to return to the process of Rémy, which consists in "sowing" herbivorous fishes in the streams populated by the trouts. M. Millet is still engaged in his labors, and we shall endeavor to keep our readers acquainted with the progress of this new branch of industry.

On the destruction of insects by gaseous injections.—On the same occasion with the reading of the preceding memoir, another relating to ap-

plied zoology, was communicated to the Academy by M. Quatrefages. This naturalist has also acted an important part in the history of pisciculture, for it was in consequence of his memoir published in 1847, on the possibility of repeopling the water-courses by artificial fecundations, that the Academy took a favorable notice of the letter in which M. Haxo reported on Rémy's processes in the Vosges. In the present memoir he aims at destroying an animal well known for its ravages—the Termites (Termes lucifugum, *R.*). This Neuroptera has been especially destructive about the villages of Saintes, Tonnay-Charente, and Rochefort. Roofs and floors are often completely riddled in these villages by these animals so feeble in appearance; and even entire houses have been so destroyed in their foundations, that they had to be abandoned or rebuilt. The danger from these depredators is the greater, that they work altogether out of sight, and respect with extreme care the surface of the bodies they attack. The Archives of Rochelle for certain years have been completely devoured by the termites, (excepting the outer surface which gives no evidence of the destruction within,) and of recent years they have been enclosed in zinc. At La Rochelle the invasion has even extended to the Arsenal and the Prefecture, and the whole village is threatened.

M. de Quatrefages has made some experiments, which solves the problem of their destruction. He has shown that the gases which are most energetic are chlorine and nitrous vapor NO_4; sulphurous acid is less active, and oxyd of nitrogen, NO_2, acts only when it can be transformed into hyponitric acid, under the influence of a little oxygen. These gases have been made to act on fragments of wood infested with the termites, and have so penetrated into the deeper termitic cellules, that none have escaped.

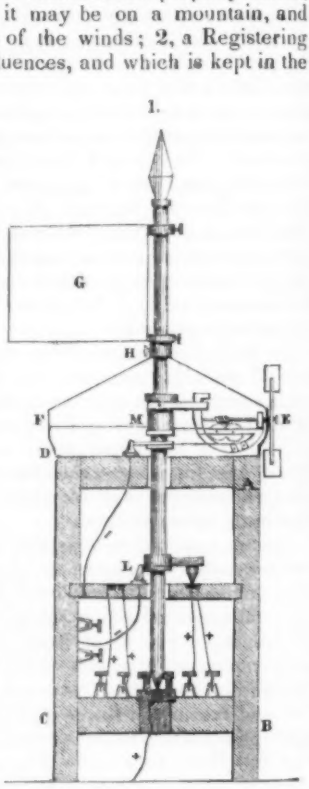
As the application of gas in many cases must be inconvenient, it is recommended to prepare the wood before employing it in construction. The method hitherto employed for preserving woods, have had reference rather to protection against decay than insects. There is an exception in the proces of Bethell, which consists in saturating the wood with a bituminous oil rich in naphthaline, a material proceeding from the distillation of the bitumen of coal. The cross-timbers of the Stockton and Barlington Railway, prepared in this way, ten years since, are still untouched; and the same is true of the timbers of part of the London and Northwestern Railway. At the port of Lowestoft, the naphthalized piles are wholly exempt from the attacks of insects, while wood unprepared is more or less deeply eaten. The disastrous results mentioned by M. de Quatrefages, will not fail to call attention to this process which has been sometimes objected to on account of its making the wood more combustible.

Electro-magnetic Anemometer.—For some time past, the merits of a new electro-magnetic anemometer have been under discussion among the savants of Paris, which, by a recent improvement, has reached a sensibility that enables it to mark the direction, velocity, continuance, and succession of changes in the winds; and moreover, the apparatus gives monthly recapitulations of the observations such as are needed for calculating the means of the months, and relieves the observer consequently of the trouble of reviewing, counting and measuring the marks

drawn by the registering crayons. As M. Arago is about to give to this instrument the honors of the observatory, we will enter into some details in its description.

Figures 1 and 2 are drawn from the apparatus such as it was when its author, M. Dumoncel, presented it to the Academy of Sciences. It consists of two distinct parts: 1, of the Anemometer properly called, which is placed on a roof, tower, or it may be on a mountain, and which receives the different influences of the winds; 2, a Registering apparatus, which registers all these influences, and which is kept in the room of the observer.

1. *The Anemometer properly so-called.*—It consists of a cylindrical box ABCD, (fig. 1,) at the center of which turns a weathercock or vane G, on a moveable axis, which carries a Woltmann's windmill ("moulinet") ME, and a bent lever L to act on a commutator. The box ABCD is covered with zinc; it is bounded by an elevated border AE, DF, above which a roof "en parasol" FHE is soldered to the axis of the vane. The windmill ME, can thus turn freely with the weathercock and is secure from the rains.



The commutator connected with the lever L, consists of a plain metallic circle, divided into eight sectors isolated from one another by threads of ivory. Each of these sectors is in connection with a metallic wire passing from the index apparatus, and going to one of the poles of the battery. The other pole has a metallic communication with the lever L. In order to insure the contact of this lever with the conductor which supplies the current, M. Dumoncel employs two metallic springs pressing constantly on the lever L.

From this arrangement, it is seen that if the eight sectors of the flat metallic crown are so arranged as to correspond to the 8 principal winds, and the lever L is made to act constantly on the metallic crown, it follows that the current will be established in one or the other of the 8 wires, according to the direction of the vane. The changes of direction in the wind will hence be indicated by the continuance or the rupture of the current in the 8 wires which correspond to its different directions.

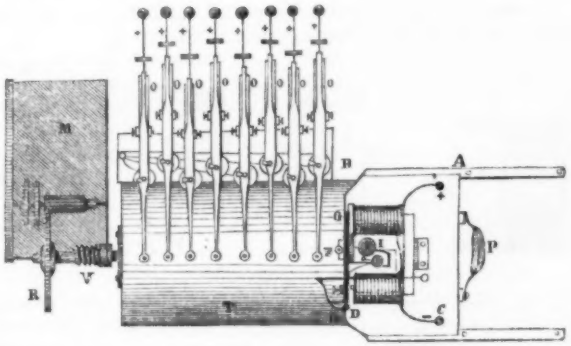
We may now consider how the *velocity* of the wind furnishes indications. The windmill of Woltmann consists, as is known, of four wings, which turn the more rapidly the stronger the wind; and the degree of

rapidity is measured by a register or counter on which it acts; an endless screw fixed upon the axis of the windmill works into a system of cog-wheels, so combined, that when the last makes one turn, the windmill makes 500. The apparatus being fixed on the axis of the vane and perpendicularly to the direction of the wind, let us suppose that one of the conductors is connected with it, and that the other conductor ends at a small metallic spring fixed within reach of the last wheel of the counter, being isolated from the apparatus by plates of ivory. If then, at the zero point of this wheel of the counter, a small metallic button is soldered, the spring, on touching against this button, at each turn of the wheel, will close the current for each of the five hundred turns of the windmill. The current in connection with this part of the apparatus will then be closed at intervals more or less distant.

The current is transmitted to the windmill by means of the axis of the vane. The bent lever L is by a simple means isolated from the axis. The return current arrives at the spring of the counter, by a mode of transmission analogous to the preceding; two springs press upon a metallic ring which is fixed upon the axis of the vane over an intermediate plate of ivory: this ring may be put into communication with the spring of the counter; and the current may be closed or interrupted in the windmill independently of its motion with the vane.

2. *Registering Apparatus*, (fig. 2.)—For registering in the observers apartment the various changes, M. Dumoncel introduces into the circuit formed by each of the eight wires corresponding to the different winds, an electro-magnet whose armature is furnished with a crayon which falls whenever the current is established, and leaves its mark on a sheet of paper arranged for the purpose. These eight electro-magnets represent each a wind; they are placed parallel to one another. A ninth in a horizontal position corresponds to the circuit of the windmill.

2.



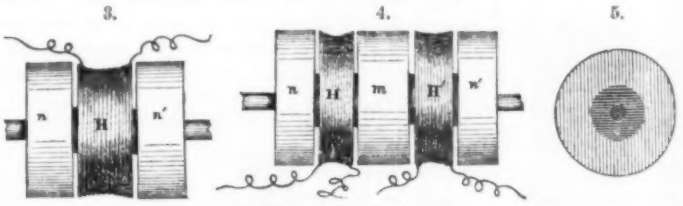
A cylinder T, serves to mark the time for the indications afforded by the electro-magnets; it is connected with a clock movement and revolves once in 12 hours It is covered with a sheet of paper, and the crayons of the vertical electro-magnets come in contact with it at a point whose height on the cylinder indicates the direction of the wind

then blowing. While the wind is from a given direction, the same crayon rests upon the cylinder, and leaves a trace, the length of which shows how long it continued; and when the vane changes, another crayon falls, and so on. By measuring all these tracings, the duration of each wind for the 12 hours is ascertained.

To simplify the reduction of the observations marked on 30 sheets of paper by the 8 crayon points, M. Dumoncel unites to his registering apparatus, an axis revolving in 12 hours, and furnished with 8 electro-magnets forming a new system. These electro-magnets, of a circular form, as described below, are put in connection by means of armatures ("galets") of soft iron, with 8 counters corresponding each with one of the 8 helices which carry the crayons, so that the current passes at the same time in the helix and in the electro-magnet.

It is seen that whilst the axis which carries these electro-magnets turns by means of a clock movement, each electro-magnet is magnetized as often as the wind causes the crayon to act which is in communication with the helix of this electo-magnet. But each time that this electro-magnet is set in action, the soft iron armature which turns around with it also in the 12 hours, and which is kept raised by an opposing spring, falls, causing the lever of the counter to move, and adds a unit to the number marked by this counter. Finally, M. Dumoncel states that he is able to indicate directly by his apparatus the monthly means for the rapidity of the wind.

On circular Electro-magnets.—I give in this place some brief explanations relative to the new circular electro-magnets which were brought into use soon after I had presented the subject to the "Société d'Encouragement." They are intended for transmitting motion where great velocity and regularity is required, and when the ordinary methods, as by leather belts, affords imperfect results. The principle on which these electro-magnets are constructed serves also to increase the adhesion of the driving wheels of locomotives and may therefore be used on railroads of heavy grade, curves of small radius, and thus do away with numerous works such as tunnels, etc.



CIRCULAR ELECTRO-MAGNETS.

Figures 3, 4 and 5 represent these magnets. Conceive of a pulley of iron within which is lodged an insulated copper wire. This wire is wound on the middle of the pulley: it makes part of its mass, or better, it is independent and wound upon a spool of brass which surrounds the middle without touching it. In the former case, the helix communicates with the pile by the known methods; in the second, it is directly connected with the poles of the battery, for it is fixed and the iron pulley alone is moveable.

Let us consider for a moment figure 3. When the current is established, the electro-magnet is divided into two parts magnetically distinct, one boreal, n, and the other austral, n', and since the helix surrounds the middle of the pulley, it is evident that each of the circles is equally magnetized in each point of its circumference and that the magnetization is maintained thus during repose as well as motion.

Figure 4 represents a pulley with two channels, and consequently, with two helices, by means of which we may produce an electro-magnet "à point conséquent" if a contrary direction is given to the current, or if a normal electro-magnet having contrary poles at the extremities is used and the currents have the same direction.

This magnetic traction, operating as seen between turned pullies which are consequently without teeth, is attended with much less friction than where there are ordinary cog wheels; and the rapidity of the movement may be rendered as great as possible without being restricted to a certain relation between the diameter of the magnetized pulley and the armature pulley.

With a pulley like figure 4, 34 centimeters in diameter, I have obtained three horse-power of force with a velocity of 300 turns per minute. The sum of the thicknesses of the three circles was seven centimeters. In the next number, I will treat fully of this subject of circular electro-magnets, which has received in Dumoncel's anemometer only a limited application since great rapidity is not required.

On Inductive Electric machines and on a simple means of increasing their effects.—The inductive machine described by us in the January number of this Journal, invented by M. Ruhmkorff, greatly interests experimenters, and is leading to many new observations. It is however inconvenient if desired to be used as an ordinary electric machine, where there is need of an increase of tension. This is owing to the fact that at each induction, the inducing wire gives passage to an induced current which increases considerably the electric tension at the point where a spark is given out from the interruptor. This spark acts it is true on connections of platinum: but its energy is such that the surfaces are soon tarnished, fused and bored through; and the vibrations becoming thus less constant, the production of electricity ceases to be regular. An attentive study of this machine has led M. Fizeau to observe that the current of induction which is produced in the inducing wire at the moment of the rupture of the circuit, exerts a strong influence on the production of the electricity in the induced wire which terminates at the two poles of the machine. When this current is produced freely and becomes strong, the poles of the machine give little electricity; but if the current meets with obstacles and is only feeble, the poles have much electricity and the power of the machine is far greater. Several arrangements satisfactorily prove this, such as the use of metals, less liable to be acted upon than platinum, upon the surfaces of the interruptor, and uniting the vibrating parts by fine wires of different lengths.

The means of increasing the power of the machine is then to prevent the development of the current which is produced in the inducing wire at the moment of the rupture of the circuit, by acting directly on the tension of the current and rendering it more feeble. M. Fizeau

has succeeded in applying the principle of the Leyden jar to the electric charge by means of the current induced in the inducing wire.

For this end, this physicist arranges a condenser made of two plates of tin, juxtaposed and insulated by a bed of varnish, and puts each of these plates in communication with each extremity of the inducing wire. The points of attachment should be on both sides at the point of interruption where the sparks are produced. Then the two electricities before reaching the point of interruption, spread over the two surfaces of tin, where they lose a large part of their tension through the mutual influence across the insulating coats of varnish.

When the condenser has a surface of sufficient size, five or six square decimeters for example, it is seen, as soon as the communications are established, that the light is diminished at the point of interruption, and at the same time, the machine increases remarkably in energy. The poles then give stronger and longer sparks than before.

The condenser may be conveniently placed in a horizontal position, a little above the electro-magnet and upon four supports of glass. M. Sinsteden who has described his methods in Poggendorff's Annalen, also employs the condenser, but only for the induced wire, and his apparatus presents no great advantages.

The value of Fizeau's modification of Ruhmkorff's apparatus is shown by the following fact. A galvanometer being placed in the circuit, electricity was made to pass produced by the machine in rarefied air, when the beautiful phenomena of light were shown which are mentioned in my last communication.* When the machine operated in its ordinary condition, the needle of the galvanometer indicated a deviation of 8°; but with the condenser, the light produced had a much greater brilliancy, and the deviation of the needle amounted to 15°, showing that the intensity of the current was nearly doubled. The machine with Fizeau's addition is hence rendered more powerful, and will act for a longer time in a constant manner. The arrangement may hence be advantageously used in the construction of new apparatus.

On certain chemical reactions important to health in populous cities.—Under this title, M. Chevreul has prepared a memoir in which he attempts to prove that the insalubrity of the soil of populous cities is owing to the organic matters which infilter into it and there remain. He examines the means by which the injurious influences may be diminished. The causes of salubrity are those which tend (1) *to distribute water in the soil to carry off the organic matters*, and (2) *to disseminate oxygen in it to consume these matters*; and consequently the causes which (1) *carry organic matters into the soil*, or (2) *absorb the oxygen before it has acted on these matters*, are sources of insalubrity.

Following out these views, M. Chevreul examines the influence of the paving of streets on the salubrity of the soil when considered as an obstacle to the penetration of rain waters; the influence of air; of solar light; of empyreumatic substances derived from conduits of gas; of the water running from public fountains; of sulphate of lime and of organic matters in producing an alkaline sulphuret, etc.

* This volume, page 99.

It would not be possible to mention here the important facts of this memoir; the results below are from a note which M. Chevreul has annexed to his paper. The whole will appear in the Memoirs of the Academy of Science.

This note relates to the examination of the black material found under the pavements of the streets of Paris and between the stones. It owes its origin to the iron rubbed off from the tires of carriage wheels and shoes of horses, and is carried into the pavement by the rains. In its fine state of division, the iron readily oxydizes under the agency of the air and moisture, becoming first magnetic oxyd and then peroxyd; and moreover, from the analysis of this material, it has been found that there is a large quantity of sulphuret of iron. The presence of such a bed in the soil, tends, according to M. Chevreul, to deprive of oxygen the air which penetrates it, and it should therefore be considered an obstacle to the salutary influence of the atmospheric oxygen.

M. Chevreul also mentions the following facts. Iron put in contact with plaster in a flask not hermetically sealed, at the end of seven years is changed into black magnetic oxyd with a little ammonia. If albumine is added to the mixture, a large quantity of chlorohydrate and sulphate of ammonia is produced with some magnetic oxyd and peroxyd of iron. Also by adding to the iron plaster and water, some gum arabic, a mixture of butyrate and acetate of peroxyd of iron is produced. In neither of these cases was a sulphuret formed.

On the reproduction of engravings and designs by means of the vapor of iodine.—Among the 2,000,000 of unproductive beings which are supported in Europe at public expense, to parade public places and amuse the idle, M. Niepce de St. Victor is an exception. Captain of the guards at Paris, he employs his leisure hours at the barracks in extending the domain of photography, and continues thus in the course which his uncle, Niepce, opened by the part which he took in the invention of the daguerreotype. Numerous discoveries have proceeded from his researches. He has just now completed a work, the first part of which appeared in 1847, treating of the effect of using different vapors, and especially that of iodine, in photography. He has shown that the vapor of iodine diffuses itself over the black lines in an engraving, to the exclusion of the white, and that we may reproduce the image on paper prepared with starch, or on glass covered with it, and thus form a design, the colored part of which will be iodid of starch. These designs are however not permanent. But M. Niepce has pursued the subject, and by the following method they are rendered unalterable.

If the design obtained as just mentioned is plunged into a solution of nitrate of silver, it disappears; but on exposing the paper or glass for some seconds to the light, the original design of iodid of starch is changed into iodid of silver; and by further exposure to the light, this iodid, being much more sensitive than the nitrate of silver contained in the paper or in the layer of starch on the glass, is acted upon before the nitrate; it is then only needed to plunge the glass or paper into a solution of gallic acid to bring out the original design, which is then treated with hyposulphite of soda, just as for photographic pictures. The pictures are thus rendered as permanent as ordinary photographs.

M. Bayard the skillful photographer, has just made another application of iodine. After exposing the engraving to the vapor of iodine, he applies it to glass prepared with sensitive albumen, in order to produce a negative proof, he then with this obtains positive proofs on paper by the known processes. He has thus made some most magnificent copies of very old engravings, without defacing in any way the originals.

On the application of fatty acids to illumination.—While science is in search of a more economical process than those now used for making fatty acids, we can do nothing better towards diminishing the cost, than to perfect the methods employed, and especially to so manage the saponification as to obtain a useful residue, and not a product of no value, such as sulphate of lime, which is formed by the decomposition of calcareous soap by sulphuric acid.

Under this idea, M. Cambacéres has modified this kind of manufacture, by combining the sulphuric acid with alumina, so as to obtain a residue of some commercial value.

Alumine does not saponify directly: but M. Cambacéres overcomes this difficulty, by availing himself of the property, which some alkaline soaps have, of dissolving alumine. He uses clay, which is mainly alumine; and as the solution goes on, the alkali separates from the fatty body with which it was combined. The aluminous soap thus formed, is then precipitated by the aid of an excess of alkali, a large quantity of water, or a saline solution. The soap separates in a gelatinous mass, and its decomposition is effected without difficulty by means of the acid. The silica of the clay separates from the alumine when the saline solution is concentrated in order to obtain the salt in a solid state.

Different memoirs.—Among the various papers presented to the Academy, we mention the *researches on the composition of sweat*, by M. Favre. By operating on large quantities of this secretion, M. Favre has detected a new acid, having the constitution of *creatine*, *sarcosine*, etc., which he calls *hydrotic acid*. The subject from whom he procured the material for examination was a philanthropic physician, Dr. Tecker, who voluntarily exposed himself to a high temperature, and thus furnished M. Favre 40 litres of sweat.

Researches on the presence of boracic acid in mineral waters.—MM. Baup, Bouis, Filhol, Béchamp of Strasburg have in turn recognized boracic acid in the mineral waters of different provinces, by using Rose's test, which depends on the red color produced by boracic acid on turmeric paper in the presence of chlorohydric acid.—In a memoir by M. L. de Munster, (Upper Rhine,) *on cubic alum*, the author shows that cubic and ordinary alum are identical; and that the cubic form is a result analogous to many facts long since explained by Beudant.

On Phycite, by M. Lamy, (of Lille).—Phycite is a saccharine substance obtained from an Alga, the Protococcus vulgaris, known under the name "Phycie." It does not ferment, nor act on polarized light; it is not altered by potash, and does not form definite compounds with bases. It contains one equivalent of hydrogen more than mannite.

$$C^{12}\ H^{15}\ O^{12}\ \text{(Phycite)} = C^{12}\ H^{14}\ O^{12}\ \text{(Mannite)} + H.$$

On the composition of the air confined in vegetable mould.—M. Boussingault, in this paper gives an account of numerous experiments

made by him, in connection with one of his students, M. Lévy. The researches were carried on during the last summer on the fine estate of Bechelbronn,—so celebrated in agronomic investigations, owing to the numerous works here executed by M. Boussingault. Situated in a region peculiarly agricultural, and one of the richest in France—the Lower Rhine—surrounded with vineyards and cultivated fields of other kinds, alongside of the mine which furnishes the asphaltum called *Lobsann*, and near by a deposit of rock salt, it has furnished this illustrious observer many occasions for utilising his varied knowledge. It was at Lobsann that he made the first attempts towards lighting mines by electric light.—*A report by M. Dumas on the anhydrous acids discovered by Gerhardt*, the conclusions in which are favorable to the views in the memoir, is a triumph for the ideas sustained by Laurent and with him by Gerhardt. Unfortunately, this triumph finds Laurent on his deathbed.—There are also important *researches on granite*, by M. A. Delesse; a report by M. Dufrénoy, *on the phenomena which accompany the crystallizations of sulphur and phosphorus*, by M. Brame; a memoir by M. Bérard, on the manufacture by heat of artificial blocks for hydraulic structures;—and many others in different branches of the physical sciences. One memoir which escapes classification, has for its title, *the divining rod applied to the search for subterranean waters and metals*, the author of which, an inhabitant of the Isles d'Hières, offers to make the journey to Paris to repeat before the Academy his experiments if they desire it.

A like activity has prevailed for the two months past in the "Société d'Encouragement," of which M. Dumas is President. Thus he has examined and controlled in all its details the process for the commercial assay of cyanid of potassium by MM. Fordos and Gélis;* also a process for restoring tin-foil to mirrors:—a report made by M. Felix Leblanc on the use of the submarine boats of M. Poyerne in fishing for coral and sponges;—a report of M. Barreswill on a manufacture of caoutchouc thread, just established at Grenelle by MM. Gérard and Aubert, and which constitutes a new branch of industry, as the Gerard process substitutes a thread of india rubber obtained by pressure for the uneven thread used in elastic tissues made mechanically by cutting, etc.

The "Société d'Encouragement" is occupied with a multitude of questions in applied science, but I am compelled to refer the reader for particulars to a future communication.

II. Chemistry and Physics.

1. *Specific heat of gases and vapors.*—Regnault has communicated to the Academy of Sciences some of the numerical results obtained in an elaborate investigation of this important and hitherto little understood subject. The details of the methods employed are not given by the author in the sketch furnished by him to the Academy, and we therefore can give in this place only the numerical data themselves. These are as follows. The column A gives the specific heats by weight, and B by volume.

* This Journal, xv, p. 112.

	A.	B.		A.	B.
Air,	0·2377		Vapor of alcohol,	0·4513	0·7171
Oxygen,	0·2182	0·2412	Vapor of ether,	0·4810	1·2296
Nitrogen,	0·2444	0·2370	Chlorid of ethyl,	0·2737	0·6117
Hydrogen,	3·4046	0·2356	Bromid of ethyl,	0·1816	0·6777
Chlorine,	0·1214	0·2962	Sulphid of ethyl,	0·4005	1·2568
Bromine,	0·0551	0·2992	Cyanid of ethyl,	0·4255	0·8293
Nitrous oxyd,	0·2238	0·3413	Chloroforme,	0·1568	0·8310
Nitric oxyd,	0·2315	0·2406	Dutch liquid,	0·2293	0·7911
Oxyd of carbon,	0·2479	0·2399	Acetic ether,	0·4008	1·2184
Carbonic acid,	0·2164	0·3308	Acetone,	0·4125	0·8341
Bisulph. of carbon,	0·1575	0·4146	Benzole,	0·3754	1·0114
Sulphurous acid,	0·1553	0·3489	Oil of turpentine,	0·5061	2·3776
Chlorohydric acid,	0·1845	0·2302	Chlorid of phosphorus,	0·1346	0·6386
Sulphydric acid,	0·2423	0·2886	Chlorid of arsenic,	0·1122	0·7013
Ammonia,	0·5080	0·2994	Chlorid of silicon,	0·1329	0·7788
Protocarb. of hydrogen,	0·5929	0·3277	Chlorid of tin,	0·0939	0·8639
Bicarb. of hydrogen,	0·3694	0·3572	Chlorid of titanium,	0·1263	0·8634
Vapor of water,	0·4750	0·2950			

The author directs attention to the very remarkable fact that the specific heat of the vapor of water, namely 0·475, is very nearly the same as that of ice and about half that of water itself. Other very valuable numerical data are promised in subsequent communications.—*Comptes Rendus*, xxxvi, 676, 18th April, 1853.

2. *On the decomposition of certain organic acids.*—Chiozza has studied in Gerhardt's laboratory the action of caustic potash upon acrylic, angelic and oleic acids, and has obtained results of great interest and importance for the study of the fatty acids in general. When acrylate of potash is heated with an excess of caustic potash it is resolved into a mixture of formate and acetate of potash, with disengagement of pure hydrogen gas. Similar decompositions occur with angelic and oleic acids and may be represented by the following equations.

$$C_6H_4O_4+2KO,\ HO=C_4H_3O_3,\ KO+C_2HO_3,\ KO+2H$$
$$C_{10}H_8O_4+2KO,\ HO=C_4H_3O_3,\ KO+C_6H_5O_3,\ KO+2H$$
$$C_{36}H_{32}O_4+2KO,\ HO=C_4H_3O_3,\ KO+C_{32}H_{31}O_3,\ KO+2H$$

These remarkable reactions not merely demonstrate the existence of a series of acids homologous with oleic acid, but exhibit the relations of this group with the formic acid series in a very striking manner. Chiozza has furthermore found that cinnamate of potash heated with excess of caustic potash yields acetate and benzoate of potash and hydrogen. The equation is

$$C_{18}H_8O_4+2KO,\ HO=C_4H_3O_4,\ KO+C_{14}H_5O_3,\ KO+2H.$$

Thence it would appear that cinnamic acid stands in the same relation to benzoic acid that acrylic acid does to formic acid, or oleic to ethalic (palmitic) acid, and we have thus a further analogy between the acetyl and benzoyl series, or between the methyl and phenyl series.—*Comptes Rendus*, xxxvi, 701.

3. *New organic radicals containing Tin.*—Löwig has communicated the results of an elaborate investigation of the products resulting from the action of iodid of ethyl upon alloys of tin and sodium. These results are of great interest, and throw much light upon the nature and structure of organic radicals. The alloys of tin and sodium employed, were obtained by simply melting tin in an earthen crucible and adding

sodium while still moistened with naphtha. The author prefers an alloy of 1 part of sodium with 6 parts of tin which is crystalline, silver-white, and easily pulverized. It is to be quickly reduced to powder, mixed with quartz sand, and introduced into small glass flasks of three or four ounces capacity, iodid of ethyl is then added, and the flask quickly connected with a tube and condenser. The action commences almost immediately with evolution of much heat, and the excess of iodid of ethyl distils over. The flask is then to be quickly closed, and the operation repeated with a second flask, and so on till a sufficient quantity of the iodid has been consumed. After cooling, the contents of the flasks are again treated with iodid of ethyl, and the above operations repeated. After cooling again, the mass in the flasks is perfectly dry and like dust, of a yellowish color, and intolerable odor. The contents of the flasks are then introduced into a flask filled with ether, and allowed to remain one or two hours with frequent agitation. The dark yellowish brown colored solution is then to be poured into a bottle filled with carbonic acid, and permitted to stand from half an hour to an hour. During this time, a brownish substance separates, which when collected on a filter dries to a white mass without odor. The etherial solution now contains five or six organic radicals, and a number of iodine compounds: these last are present in larger quantity when the contents of the flask contain no undecomposed alloy; when this however is the case, the radicals are usually alone present. The author bases his method of separation upon the fact, that the radicals are insoluble, or nearly so in absolute alcohol, while the iodids are readily soluble even in dilute alcohol; for the details of the processes employed we must refer to the original memoir. The new substances resulting from the action of iodid of ethyl upon alloys of tin and sodium, are, according to Löwig seven in number, namely,

Stannethyl, - - -	Sn Ae
Methylenstannethyl, - -	Sn_2 Ae_2
Elaylstannethyl, - -	Sn_4 Ae_4
Acetylstannethyl, - -	Sn_4 Ae_3
A Radical, - - - -	Sn_6 Ae_4
Methstannethyl, - - -	Sn_2 Ae_3
Ethstannethyl, - - -	Sn_4 Ae_5

in which Ae is the symbol for ethyl C_4 H_5. Stannethyl and its compounds have already been described by Cahours and Riché, and more recently by Frankland, so that we may omit Löwig's account of this radical. The author did not succeed in isolating methylen-stannethyl Sn_2 Ae_2, but gives the description and analysis of the oxyd, iodid and chlorid, which are represented by the formulas Sn_2 Ae_2O, Sn_2 Ae_2I, and Sn_2 Ae_2Cl. The iodid and chlorid are colorless and crystalline; the oxyd is a white powder without taste or smell.

Elaylstannethyl is a colorless oily liquid of density 1·410; Sn_4 Ae_4O is a snow white amorphous powder which is precipitated from its compounds by ammonia and potash, which last when in excess dissolves it. It forms colorless salts soluble in alcohol and ether, and precipitated by water from the alcoholic solution. The author describes a colorless and crystalline nitrate, chlorid, bromid, and iodid of this radical; they are all anhydrous.

Acetylstannethyl is a colorless oily liquid which was not obtained perfectly pure; the oxyd $Sn_4 Ae_3O$, is a white amorphous powder, soluble in caustic potash; its salts are scarcely soluble in water, but soluble in alcohol.

The nitrate $Sn_4 Ae_3O, NO_5$ crystallizes is small brilliant crystals; the iodid $Sn_4 Ae_3I$ in needle-like crystals grouped together; the bromid is also crystalline. The compounds of the radical $Sn_6 Ae_4$ are not crystalline, and doubt may be entertained as to their true constitution.

Methylstannethyl appears also to be a colorless oily liquid; the oxyd was obtained as a crystalline hydrate, somewhat volatile, soluble with difficulty in water, more easily in alcohol and ether; it is represented in the formula $Sn_2 Ae_3 O+HO$, but contains also water of crystallization. Its taste is strongly caustic and penetrating; it takes up carbonic acid quickly from the air, and precipitates all metallic oxyds from their salts. With the single exception of nitric acid, it forms with acids finely crystallized salts. The author describes the nitrate, sulphate, iodate and bromate, as well as the iodid, bromid and chlorid. The three last are colorless oily liquids, which have a penetrating smell of oil of mustard and irritate the nose and eyes.

Ethylstannethyl appears also to be a colorless oily liquid; its compounds closely resemble those of methylstannethyl. The haloid salts of these radicals are immediately reduced by potassium and sodium, the radical being set free.

The author closes his memoir with a discussion of the theoretical signification of the results which he has obtained. He considers the constitution of the compounds of tin and ethyl as demonstrating that, in organic substances, tin may replace carbon, equivalent for equivalent, and states that he has also discovered similar bodies in which carbon is replaced by lead. The following formulas show at once the advantages, and even necessity, of this view.

Methylen,	C_2H_2	Methylen stannethyl,	Sn_2Ae_2
Elayl,	C_4H_4	Elayl stannethyl,	Sn_4Ae_4
Acetyl,	C_4H_3	Acetyl stannethyl,	Sn_4Ae_3
Methyl,	C_2H_3	Methyl stannethyl,	Sn_2Ae_3
Ethyl,	C_4H_5	Ethyl stannethyl,	Sn_4Ae_5

As these are the first instances on record of a replacement of carcarbon by another element their importance is very great. The author states further that he has reason to assert the existence of radicals composed of tin and hydrogen analogous to the hydrocarbons, and points also to the probability that compounds of carbon with ethyl and methyl exist, similar to those of tin with the same radicals.—*Journal für prakt. Chemie*, lvii, 385.

4. *On a new series of organic bodies which contain metals.*—Frankland has presented to the Royal Society a memoir on the compounds of ethyl, methyl, &c., with zinc, mercury, and other metals, a class of compounds the existence of which was first recognized by himself some years since and some of the members of which have since been investigated by other chemists. The compounds in question were all obtained by the direct action of the iodids of methyl, ethyl, and amyl

upon the metals themselves, the reaction being brought about by the influence of light, or of heat, or of both these agents. The materials employed were enclosed in glass tubes and either plunged for half their length into an oil bath, or exposed in the focus of an 18 inch parabolic concave mirror. By the action of iodid of ethyl upon metallic tin the author obtained *stannethyl*—a radical which was also obtained by Cahours and Richè, and by Löwig—and which has been fully described in this Journal. Stanmethyl and stanamyl were obtained in a similar manner, and their salts according to Frankland are isomorphous with those of stannethyl.

When iodid of methyl and zinc are exposed to a temperature of 150° C. in a closed tube, the zinc gradually dissolves with evolution of gas, while a mass of white crystals, and a colorless mobile highly refractive fluid, make their appearance. The gas evolved is methyl C_2H_3, the liquid zincmethyl, C_2H_3Zn. Zincmethyl possesses a peculiar penetrating and intolerable smell; it is very volatile and unites directly with oxygen, chlorine, iodine, &c., to form very stable compounds. In contact with air it instantly inflames and burns with a magnificent greenish blue flame with formation of white clouds of ZnO: it decomposes water with explosive violence and with evolution of heat and light. If the decomposition be moderated so as to avoid too high a temperature, oxyd of zinc and hydruret of methyl, C_2H_3, H, are the only products. The author suggests its employment as a deoxydizing agent and also to produce replacements of chlorine, &c., by methyl. Zincethyl and zincamyl are formed in a manner precisely similar to that employed in producing zincmethyl. They are both colorless liquids and unite directly with oxygen, chlorine, &c., to form well defined compounds. Hydrargyro-methyl is produced when iodid of methyl and metallic mercury are exposed for some days to the action of sunlight. The iodid C_2H_3HgI is a white crystalline substance, insoluble in water, soluble in alcohol, ether and iodid of methyl. The isolation of the radical has not yet been attempted: the author obtained the corresponding amyl compound, but iodid of ethyl gives with mercury, ethyl, hydruret of ethyl, and olefiant gas. Some preliminary experiments with other metals gave analogous results; the author mentions arsenic, antimony, chromium, iron, manganese and cadmium as promising interesting results.—*Ann. der Chemie u. Pharmacie*, lxxxv, 329.

W. G.

5. *Note on Ozone.*—In accordance with the investigations of Becquerel and Frémy, Dr. J. Schiel, of St. Louis Mo., discovered last year that ozone is oxygen in a highly electro-negative condition, and furthermore that air or oxygen ozonized by means of phosphorus, light, or any other method, may be combined with non-ozonized air or oxygen to form a galvanic circuit in which the ozonized gas is the electro-negative element. These results were obtained by Dr. Schiel before the results of the experiments of Becquerel and Frémy were made known. —*Extract from a letter of Dr. Schiel.*

III. Geology.

1. *Inundations of the Delta of the Mississippi:* The Mississippi and Ohio Rivers containing plans for the Protection of the Delta from Inundation, and Investigations of the Practicability and cost of improving the Navigation of the Ohio and other Rivers by means of Reservoirs, with an Appendix on the Bars at the Mouths of the Mississippi, by Charles Ellet, Jr., Civil Engineer. 366 pp., 8vo. Philadelphia, 1853. Lippincott, Grambo & Co.—The views in this work on the Mississippi were originally presented in a report to the War Department and published among the Executive Documents of the Senate. The surveys were directed by the Secretary of War under the authority of an act of Congress. The results of the investigations are here brought out in excellent style with numerous maps and cuts in illustration of the subject. The following citations from the Introduction of the work give an idea of the author's plan.

"The greater frequency and more alarming character of the floods are attributed—

Primarily, To the extension of cultivation throughout the Mississippi Valley, by which the evaporation is thought to be, in the aggregate, diminished, the drainage obviously increased, and the floods hurried forward more rapidly into the country below.

Secondly, To the extension of the levées along the borders of the Mississippi, and of its tributaries and outlets, by means of which the water that was formerly allowed to spread over many thousand square miles of low lands, is becoming more and more confined to the immediate channel of the river, and is, therefore, compelled to rise higher and flow faster, until, under the increased power of the current, it may have time to excavate a wider and deeper trench to give vent to the increased volume which it conveys.

Thirdly, To *cut-offs*, natural and artificial, by which the distance traversed by the stream is shortened, its slope and velocity increased, and the water consequently brought down more rapidly from the country above, and precipitated more rapidly upon the country below.

Fourthly, To the gradual progress of the delta into the sea, by which the course of the river, at its embouchure, is lengthened, the slope and velocity there are diminished, and the water consequently thrown back upon the lands above.

It is shown that each of these causes is likely to be progressive, and that the future floods throughout the length and breadth of the delta, and along the great streams tributary to the Mississippi, are destined to rise higher, as society spreads over the upper states, as population adjacent to the river increases, and the inundated low lands appreciate in value.

For the prevention of the increasing dangers growing out of these several co-operative causes, six distinct plans are discussed and advocated:—

First. Better, higher, and stronger levées in lower Louisiana, and more efficient surveillance:—a local measure, but one requiring state legislation, and official execution and discipline.

Second. The prevention of additional cut-offs; a restraint which may call for national legislation, or possibly judicial interference, to prohibit the States and individuals above from deluging the country below.

Third. The formation of an outlet of the greatest attainable capacity, from the Mississippi to the head of Lake Borgne, with a view, if possible, to convert it ultimately into the main channel of the river.

Fourth. The enlargement of the Bayou Plaquemine, for the purpose of giving prompt relief to that part of the coast which now suffers most from the floods, viz.: to the borders of the Mississippi from above Baton Rouge to New Orleans.

Fifth. The enlargement of the channel of the Atchafalaya, for the purpose of extending relief higher up the coast, and conveying to the sea, by an independent passage, the discharge from Red River and the Washita.

Sixth. The creation of great artificial RESERVOIRS, and the increase of the capacity of the lakes on the distant tributaries, by placing dams across their outlets, with apertures sufficient for their uniform discharge —so as to retain a portion of the water above until the floods have subsided below. It is proposed by this process to compensate, in some degree, for the loss of those natural reservoirs which have been and are yet to be destroyed by the levées; and, at the same time, and by the same expedient, improve the navigation of all the great tributaries of the Mississippi, while affording relief to the suffering and injured population of the delta.

It will be seen that these several plans harmonize with each other, and may be carried on simultaneously.

It will be shown, moreover, that they will all be needed, and that they must be adopted promptly and prosecuted vigorously, to afford efficient and timely protection; and that, if adopted, and pressed forward boldly, they will ultimately secure the immediate object of Congress—the protection of the coasts of the Mississippi from overflow, and, simultaneously, the perfection of twenty thousand miles of precarious navigation, and the ultimate drainage and cultivation of fifteen or twenty millions of acres of uninhabitable swamps."

As we have not space to follow the author through his argument, we only cite in this place a few from among the many valuable facts brought out by the author.

"To be able to form a just conception of the present physical constitution of the delta, and the causes of its overflow, we must imagine a great plane sloping uniformly from the mouth of the Ohio, in a direction deviating but little from a due southerly course, to the Gulf of Mexico. The length of this plane, from the mouth of this river to the waters of the gulf, is 500 miles. Its northern extremity is elevated 275 feet above the surface of the sea, and is there and every where nearly level with low water in the Mississippi River. Its total descent, following the highest surface of the soil, is about 320 feet, or at the rate of 8 inches per mile.

The breadth of this plane, near the mouth of the Ohio, in an east and west direction, is from thirty to forty miles; and at the Gulf of Mexico it spreads out to a width of about one hundred and fifty miles.

It is inclosed on the east and west by a line of bluffs of irregular height and extremely irregular direction.

This plane, containing about 40,000 square miles, has been formed in the course of ages from the material brought down from the uplands by the Mississippi and its tributaries. The river has therefore raised from the sea the soil which constitutes its own bed. It flows down this plane of its own creation, in a serpentine course, frequently crowding on the hills to the left, and once passing to the opposite side and washing the base of the bluff which makes its appearance on the west at the town of Helena.

The actual distance from the mouth of the Ohio to the coast of the gulf is, in round numbers, as stated, 500 miles. The computed length of the Mississippi River, from its confluence with the Ohio to the mouth of the Southwest Pass, is 1,178 miles; and the average descent at high water $\frac{27}{100}$ths of a foot, or $3\frac{1}{4}$ inches per mile.

The course of the river is therefore lengthened out nearly seven hundred miles, or is more than doubled by the remarkable flexures of its channel; and the rate of its descent is reduced by these flexures to less than one-half the inclination of the plane down which it flows.

In the summer and autumn, when the river is low and water is scantily supplied by its tributaries, the surface of the Mississippi is depressed at the head of the delta about forty feet, and as we approach New Orleans, twenty feet below the top of its banks. It then flows along sluggishly, in a trench about 3,000 feet wide, 75 feet deep at the head, and 120 feet at the foot, and inclosed by alluvial and often caving banks, which rise, as stated, from 20 to 40 feet above the water.

But when the autumnal rains set in, the river usually rises until the month of May, when it fills up its channel, overflows its banks, and spreads many miles over the low lands to the right and left of its trace. This leads to another important feature in the characteristics of this great stream.

The Mississippi bears along at all times, but especially in the periods of flood, a vast amount of earthy matter suspended in its waters, which the current is able to carry forward so long as the river is confined to its channel. But when the water overflows the banks, its velocity is checked, and it immediately deposits the heaviest particles which it transports, and leaves them upon its borders; and as the water continues to spread further from the banks, it continues to let down more and more of this suspended material—the heaviest particles being deposited on the banks, and the finest clay conveyed to positions most remote from the banks. The consequence is, that the borders of the river, which received the first and heaviest deposits, are raised higher above the general level of the plane than the soil which is more remote; and that, while the plane of the delta dips towards the sea at the rate of eight inches per mile, the soil adjacent to the banks slopes off at right angles to the course of the river, into the interior, for five or six miles, at the rate of three or four feet per mile."—pp. 22, 23, 24.

The width of the Mississippi in its course through the delta varies from 2200 to 5000 feet; and its depth in mid-channel, from Vicksburg to New Orleans averages 115 feet at high water, and varies between 70 and 180 feet or more. The mean velocity of the Mississippi at its

surface, according to the author, is two per cent. less than the velocity below the surface to near the bottom, and he attributes the surface retardation to contact with the atmosphere. The amount of water discharged by the Mississippi (including the discharge of the Atchafalaya) at the flood of 1850 is stated at 1,280,000 cubic feet per second. The discharge below New Orleans, at the top of the flood of 1851, was 995,000 cubic feet per second; and at Memphis, in 1850, 958,500 cubic feet. It is a remarkable fact, as the author observes, that at the same time, the discharge of water higher up the stream was much greater than this. For example, one mile below the mouth of the Ohio in June, 1851, it was 1,223,000 cubic feet, although the flood was 7 feet 10 inches below the high water of 1850; and in July 1851, at Cape Girardeau, above the mouth of the Ohio, when the water was 4 feet below the high water of 1850, it was 1,025,000 cubic feet per second. These quantities are the volumes which flowed between the banks and are independent of the waters of overflow, which enter the swamps and feed and maintain the floods below. More than 40 per cent. of the volume discharged by the channel immediately below the mouth of the Ohio, passes into the swamps of the southern counties of Missouri and the northern counties of Arkansas and escapes the measurements at Memphis.

The author treats of the local changes and irregularities of the river, arising from the crevasses, the building of levees, a change in the bends, the action of the winds, and variations in the tributaries. In the course of his remarks on the influence of the winds, he mentions that when running a test-level along both shores of Chautauque Lake, a narrow sheet of water, he detected a variation in the surface of more than 8 inches in 20 miles, produced by a continued but moderate breeze.

For the important discussions of the author upon the different modes of protection against floods, we must refer to his work.

We close by the following citations upon the Ohio river.

"This noble tributary rises on the borders of Lake Erie, at an average elevation of 1,300 feet above the surface of the sea, and nearly 700 feet above the level of the lake. The plane along which this river flows is connected with no mountain range at its northern extremity, but continues its rise with great uniformity, from the mouth of the Ohio to the brim of the basin which incloses Lake Erie. The sources of the tributary streams are generally diminutive ponds, distributed along the edge of the basin of Lake Erie, but far above its surface, and so slightly separated from it, that they may all be drained with little labor down the steep slopes into that inland sea.

From these remote sources, a boat may start with sufficient water, within seven miles of Lake Erie, in sight, sometimes, of the sails which whiten the approach to the harbor of Buffalo, and float securely down the Connewango, or Cassadaga, to the Alleghany, down the Alleghany to the Ohio, and thence uninterruptedly to the Gulf of Mexico. In all this distance of 2,400 miles, the descent is so uniform and gentle—so little accelerated by rapids—that when there is sufficient water to float the vessel, and sufficient power to govern it, the downward voyage may be performed without difficulty or danger in the channels as they were formed by nature; and the return trip might be made with equal security and success with very little aid from art."—p. 231.

Descent of the Alleghany, Ohio, and Mississippi Rivers.

	DISTANCES.	FALL.	FALL PER M.	
	Miles.	Feet.	Feet.	Inches
From Coudersport to Olean Point,	40	246	6	2
From Olean Point to Warren,	50	216	4	4
From Warren to Franklin,	70	227	3	3
From Franklin to Pittsburg,	130	261	2	
From Pittsburg to Beaver,	26	30	1	$1\frac{85}{100}$
From Beaver to Wheeling,	62	49	—	$9\frac{59}{100}$
From Wheeling to Marietta,	90	49	—	$6\frac{53}{100}$
From Marietta to Le Tart's Shoals,	31	16	—	$6\frac{17}{100}$
From Le Tart's Shoals to the mouth of Kanawha,	55	33	—	$7\frac{20}{100}$
From mouth of Kanawha to Porstmouth,	94	48	—	$6\frac{13}{100}$
From Portsmouth to Cincinnati,	105	42	—	$4\frac{80}{100}$
From Cincinnati to Evansville,	328	112	—	$4\frac{10}{100}$
From Evansville to the Gulf of Mexico,	1365	320	—	$2\frac{813}{1000}$
From Coudersport to the mouth of the Mississippi,	2446	1649		

Elevations of the Ohio River at low water.

	Feet above tide.
Mouth of Ohio, above high tide, in the Gulf of Mexico,	275
Mouth of Wabash (approximately),	297
Evansville (approximately),	320
New Albany, below the Falls,	353
Louisville, above the Falls,	377
Cincinnati,	432
Portsmouth,	474
Mouth of Great Kanawha,	522
Head of Le Tart's Shoals,	555
Marietta (mouth of Muskingum),	571
Wheeling,	620
Pittsburg,	699
Franklin,	960
Warren,	1,187
Chautauque Lake,	1,306
Olean Point,	1,403
Mouth of Oswaya,	1,419
Smithport,	1,480
Coudersport,	1,649
Surface of Lake Erie,	565

The reader will also find in Mr. Ellet's work much information on the descent of the various tributaries of the Ohio and other valuable details of geological interest.

2. *Coup d'œil sur la Constitution Géologique de Plusieurs Provinces de l'Espagne*, par MM. DE VERNEUIL et COLLOMB, *suivi d'une description de quelques Ossements Fossiles du Terrain Miocène*, par M. PAUL GERVAIS, (Extrait du Bulletin de la Soc. Geol. de France, 2nd ser., t. x, 1853. 108 pp. With maps and plates.—This memoir is throughout full

of interesting details and conclusions. The observations on which the results immediately depend were extended over a triangular space, the base of which follows the Mediterranean shore from Aliante to the vicinity of Castellon de la Plana in Valencia, and the summit lies at Madrid. The authors first describe, among the features of the surface, the great tertiary plain, or central plateau of Spain, between Madrid and Cuenca, which is 1500 square leagues (French) in surface. The average elevation of it above the sea is probably about 600 meters. Another tertiary plain of equal extent is that of the basin of the Duero, situated to the north a little to the westward, and separated from the former by the granitic chain of the Guadarrama, and having the Cantabrian chain on the north. It is nearly square, with a side to either point of the compass and has in its four corners, the villages Leon, Burgos, Salamanca and Sepulveda, and the city of Valladolid at its center. Cretaceous deposits enclose it on three sides, and metamorphic rocks, gneiss and granitic, on the other or Portugal side. Its mean height is over 700 meters.

The tertiary deposits of these two great basins are similar throughout. They are evidently lacustrine in origin, and consist of a superior calcareous bed, a median marly and gypseous, and a lower, consisting of clays, sandstone and conglomerates, every where horizontal in position; and in the last, bones of the Mastodon angustidens were found not far from Valladolid. In two mountains called Las Tetas de Viana, the tertiary rocks reach a height of 1070 meters.

The great height of these two tertiary basins above the sea is remarkable. There are other basins but they are lower, such as the basin of the Ebro, which is four or five hundred meters below those before mentioned. The authors touch upon the question of the origin of the great lakes here indicated, and remark that by the present configuration of the land there are no sufficient barriers to confine them. They were in all probability cotemporaneous and of the miocene period; and they must have existed during a long period. They occupy 2-5ths of the actual surface of Spain. It is hence evident that the present extent of Spain could not have had the rivers required to feed them; moreover, the Pyrenees which were raised at an earlier period must have prevented any ingress of waters from France. The conclusion follows that the land must have then had a wholly different configuration—and recalls involuntarily, the authors state, the Atlantis of Plato, or the opinion, more scientific, of Mr. E. Forbes, that Ireland and Spain, if not united, were so near one another that the former received from the latter some part of its actual flora.

The marine miocene beds of the coasts of Spain do not extend far towards the central plateaux. The point where they ascend highest is near the villages of Vianos, Masegoso and Villarubia, a little to the south of Alcaraz, where Pectens and Ostræas have been found in a horizontal position. It is remarkable that this point is in a line which unites the tertiary basin of Almansa with the east limit of that of the Guadalquiver and half way between the two.

The authors go on to observe, that when the tertiary beds have been thoroughly studied, it will perhaps be recognized, that in the miocene period, the Gulf of Guadalquiver communicated either by Grenada, Guadix aud Huescar, or, by a narrow passage more to the north, with

the Gulf of Murcia and isolated the Sierra Nevada and the mountains of Ronda, which then formed an island or a peninsula, separate from the continent.

M. d'Archiac has remarked (Hist. des Progrès de la Geol., ii, 841) upon the analogy in the middle tertiary period between the central plateaux of France and Spain. The two countries then constituted two peninsulas lying in a northeast and southeast direction, more or less penetrated by gulfs and having large lakes about their center. But it should be added, that the peninsula of Spain, the highest of the two, is destitute of the igneous products which during three consecutive periods were ejected through the granitic rocks of the plateau of Auvergne, and is bounded by secondary rocks that are not found in the other; and also, the lacustrine deposits in Spain have been raised to a great height, whilst the center of France, so agitated with igneous action, has apparently experienced very little change of its previous elevation.

The memoir continues with the Nummulitic, Cretaceous, Triassic and Palæozoic formations, the last including the Permian, Carboniferous and Silurian strata. The last section closes with the remark, that the lower Silurian are precisely of the same age with the Llandeilo flags of Murchison or "*Fauna Seconde*" of Barrande. There has yet been discovered no trace of the lower zone characterized by the genera Paradoxides and Olenus, or the *Lingula beds*, the "*Primordial*" of Barrande.

In the course of some observations on the "movements of the land," (p. 75) it is stated that the Peninsula limited on the north by the Pyrenees and the Cantabrian chain, is traversed obliquely from the E. N. E. to the W. S. W. by four systems of mountains; 1, the Sierra Guadarrama, which unites to the Sierras of Gredos, Gata and Estrella, and reaches quite to the ocean; 2, the mountains of Toledo; 3, the Sierra Morena, which extends into the promontory called Cape St. Vincent; 4, the high chain of the south coast which includes the Sierra Nevada, Tejeda, and Ronda. The chains may be presumed to be of different ages. The oldest occupy the center of the Peninsula; these are the mountains of Toledo and the Sierra Morena. In fact, no secondary strata have penetrated into the interior of this nucleus which is entirely palæozoic, —not even the most ancient sandstones of the trias. It is surrounded by marine or lacustrine miocene beds, which by their horizontal position seem to show that the chain has undergone no movement since their deposition. On the contrary the Sierra Guadarrama, has tilted quite strongly the chalk on its flanks, and by another oscillation has deranged the miocene. As to the chains on the north and the south, these are the most modern, or at least if they have emerged in ancient epochs, the derangements have been continued to quite a recent epoch.

Four periods of disturbance are mentioned. The *first*, separating the trias from the Palæozoic; the *second*, between the Jurassic and trias; the *third*, between the miocene and nummulitic; the *fourth*, between the miocene and pliocene. The first is well seen near Horea and Checa. The second is observed at Albarracin, etc., where the tilted jurassic beds rest on trias in a vertical or much inclined position. With reference to the third, it is quite evident that there was a general "bombement" of the surface at the end of the Cretaceous period, and at this period dates the emersion of the greatest part of the Peninsula, in the interior of which the sea has never since entered. In fact, the

nummulitic beds, unlike those of the chalk, form a zone which follows the chain of the Pyrenees, and which ascends here and there upon the coasts of the Mediterranean, but never penetrates into the interior.

The disturbance which separates the nummulitic beds from the miocene strata corresponds to one of the most agitated periods of geological history. It is that of the elevation of the Pyrenees, of the Appenines and a part of the Alps; for if the Alps have taken their defined form at a more recent epoch, it cannot be denied that between the nummulitic beds and miocene mollasse, there were disturbances and faults of vast extent.

The fourth disturbance is seen near Sabero, on the Porma and Curueño, near Fresnedo, etc., where the miocene beds have lost their horizontality.

It was after the miocene epoch that Spain was elevated to its present height above the sea. The cause seems to have had its maximum energy along a line passing by the mountains of Burgos and Soria and which extends towards Siguenza and the sources of the Tagus. The inclination of the miocene beds to the southwest was thus occasioned, a position which probably allowed the lacustrine waters of the period to flow out by the valleys along which run the Duero, the Tagus and the Guadiana.

This valuable memoir closes with a bibliography, giving a list of all papers and works hitherto published upon the Geology of Spain, extending to seven pages,—and a description of the Fossil Bones by M. Paul Gervais of Montpellier. The species of Bones figured are the Hyænarctos sivalensis, H. hemicyon, a Hipparion, Mastodon longirostris (Mast. angustidens, *partim*), Rhinoceros, a molar, Antilope Boodon, Sus palæochœrus, besides others undetermined.

3. *Palæontology of New York;* by James Hall. Vol. II.—The appearance of this volume was announced in our last number. It contains descriptions and figures of all the fossils yet observed by the author, in the Medina sandstone, Clinton group, Niagara group, Coralline limestone, and Onondaga salt-group. The entire number of species is 344, and the whole number of plates 101. The printing of the volume was nearly completed in 1850, and its issue has been prevented by delays in the engraving; and on this account, as its author states, it contains in some instances, species identical with, or allied to, those that have recently appeared.

The fossils of the several formations are referred to the following genera.

(1.) Medina sandstone.—*Plants*, Arthrophycus, *H.*, Scolithus, Palæophycus, Dictyolites; *Corals*, Chætetes; *Mollusca*, Lingula, Atrypa, Modiolopsis, Pleurotomaria ?, Murchisonia ?, Bucania, Oncoceras, Orthoceras, Cytherina.

(2.) Clinton group.—*Plants*, Buthotrephis, Palæophycus, Rusophycus, *H.*, Ichnophycus, *H.*; *Corals*, Graptolithus, Chætetes, Favistella, Caninia, Cyclolites, Cannapora, *H.*, Catenipora, Helopora, *H.*, Stictopora, Phrænopora, *H.*, Rhinopora, *H.*, Retepora, Fenestella; *Mollusca*, Lingula, Orthis, Leptæna, Strophodonta, *H.*, Chonetes, Spirifer, Atrypa, Pentamerus, Avicula, Modiolopsis, Tellinomya, Orthonota, Pyrenomœus, *H.*, Posidonia, Cyclonema, *H.*, Platyostoma, Murchisonia, Bucania, Oncoceras, Ormoceras, Orthoceras, Cornulites, Discosorus, *H.*;

Crinoidea, Closterocrinus, *H.*, Glyptocrinus, Ichthyocrinus, Caryocrinus, Tentaculites; *Trilobites*, Cybele, *Loven*, Calymene, Acidaspis, Phacops, Ceraurus, Beyrichia, *M'Coy*.

(3.) Upper gray sandstone of the Clinton group.—Myalina, Modiolopsis, Tellinomya, Pentamerus, Leptæna, Platyostoma, Orthoceras, Homalonotus.—Ichthyodorulite.

(4.) Niagara group.—*Corals*, Streptilasma, Polydilasma, *H.*, Cainia, Conophyllum, *H.*, Diplophyllum, *H.*, Syringopora, Astrocerium, *H.*, Favosites, Catenipora, Heliolites, Stromatopora, Cladopora, *H.*, Limaria, *H.*, Callopora, *H.*, Trematopora, *H.*, Striatopora, *H.*, Stictopora, Diamesopora, *H.*, Clathropora, *H.*, Retepora, Hornera, Fenestella, Polypora, Ceramopora, *H.*, Rhinopora, *H.*, Lichenalia, *H.*, Sagenella, *H.*, Dictyonema, *H.*, Inocaulis, *H.*;—*Crinoidea*, Homocrinus, *H.*, Glyptaster, *H.*, Thysanocrinus, *H.*, Myelodactylus, *H.*, Dendrocrinus, *H.*, Ichthyocrinus, *Conrad*, Lyriocrinus, *H.*, Lecanocrinus, *H.*, Macrostylocrinus, *H.*, Saccocrinus, *H.*, Eucalyptocrinus, Stephanocrinus, *Conrad*, Caryocrinus, *Say*, Melocrinites, Heterocystites, *H.*, (Cystideæ) Callocystites, *H.*, Apiocystites, *Forbes*, Hemicystites, *H.*, (Agelacrinites, *Vanux.*); *Asteriadæ*, Palæaster, *H.*; *Mollusca*, Lingula, Orbicula, Orthis, Leptæna, Spirifer, Atrypa, Avicula, Modiolopsis, Orthonota, Posidonomya? Platyostoma, *Conrad*, Acroculia, *Phillips*, Gomphoceras?, Cyrtoceras?, Orthoceras, Conularia; *Crustacea*, Bumastis, Phacops, Ceraurus, Calymene, Homalonotus, Lichas, Bronteus?, Arges, Proctus, Beyrichia, Cytherina; *Fishes* (see note below), Onchus Deweii.

(5.) Coralline limestone *of Schoharie at the base of the Helderberg*.—*Corals*, Columnaria, Diplophyllum, Favosites, Stromatopora; *Mollusca*, Orthis, Leptæna, Strophodonta, Spirifer, Atrypa, Tellinomya?, Avicula, Platyostoma, Pleurotomaria, Murchisonia?, Bucania, Bellerophon, Trochoceras, Oncoceras; *Crustacea*, Calymene, Cytherina.

Onondaga Salt-group.—Eurypterus, Pentamerus, Megalomus, *H.*, Murchisonia, Subulites, Cyclonema, Pleurotomaria, Bucania, Cyrtoceras.

Descriptions of the new genera of corals proposed by Mr. Hall in his volume were published in this Journal, vol. xi, p. 398.

We refer to the work for descriptions of the other genera as well as the species, and the excellent plates which illustrate them.

Mr. Hall's labors on the Palæontology of New York, now extended to two large quarto volumes, are yet but half finished. We trust that there will be no impediment in the way of his bringing his laborious and most valuable researches to a full completion.

Note.—In a letter to one of the editors, Mr. Hall states that Barrande has expressed to him his suspicion that the supposed Ichyodorulite, from the Niagara Group, figured on plate 71, is Crustacean. Mr. Hall observes that he had before suspected this, and adds that on reëxamination, the spine proves not to have the structure pertaining to those of fishes but rather that of a Crustacean. The articulating extremity is also Crustacean and unlike anything that has been seen in the corresponding parts of Ichthyodorulites. Mr. Hall says that we have therefore no fish remains, or none of unquestionable character, yet discovered in this part of the Silurian system. The fragments from the Clinton group, which appear to have a bony structure, have not yet been examined with a microscope.

IV. Botany and Zoology.

1. *Flora Cestrica; an Herborizing companion for the Young Botanists of Chester County, State of Pennsylvania;* by Wm. Darlington, M.D., LL.D. Third Edition, Philadelphia, Lindsay and Blakiston, 1853, pp. 498, with an introduction of 90 pages, 12mo.—The second edition of this deservedly popular work, published in 1837, was almost a model of a local Flora. To grace his 71st birth day, our worthy Nestor of American botanists, has brought out this third edition, or rather, we should say has produced a new work in its place, having carefully re-written the whole, condensed the detailed descriptions, to make room for the *Mosses, Hepaticæ and Lichens*, and arranged the whole according to the natural system. The introductory part opens with five preliminary discourses, which pleasantly discuss the scope of the science of botany, and the inducements to its study; the limits and characters of the vegetable kingdom; the doctrines of morphology; and the classification of plants, both by the artificial and the natural method. To this succeed a very full Glossary of botanical terms, a Linnæan arrangement of the genera, and a Conspectus of the natural orders, under the groups imperfectly sketched in Gray's Botanical Text-Book. In the body of the work, we miss the fuller detailed descriptions of the former edition, which were both faithful and strictly original, and therefore of great service to the botanist. These enter into our idea of a local Flora, where the moderate number of plants described does not compel the strict curtailment which the Flora of a large area imperatively requires. But we must not condemn the abridgment in the present instance, since it has made room for the Mosses, Liverworts, and even the Lichens;—the latter being here for the first time introduced into a Flora of any part of North America, except that of Michaux. Nor has the compression eliminated the characteristic touches of quaint humor and sentiment which still enliven many a page. We must not forget to state that the Mosses and Hepaticæ of this volume were elaborated by Thomas P. James, Esq., of Philadelphia, apparently with much skill and judgment, on the basis furnished by Mr. Sullivant in Gray's Manual of the Botany of the Northern States; while the account of the Lichens is contributed by Dr. E. Michener, Mr. Tuckerman's valuable Synopsis serving as the ground-work.

With such an excellent *vade mecum*, it must be a pleasure and a peculiar satisfaction to study botany in Chester County, Pennsylvania!—a county most honorably distinguished, thanks to Dr. Darlington, by the possession of a Florula of its own, for nearly thirty years, and still unique in this respect. May the excellent author and benefactor of his native county survive to see his example imitated in many other local districts of our wide country! A. G.

2. *Fungi Caroliniani Exsiccati. Fungi of Carolina, illustrated by Natural Specimens of the Species;* by H. W. Ravenel, Corresp. Memb. Acad. Nat. Sci., &c., &c. Fasc. 1. Charleston: John Russell, 1852.—As only about 30 sets of this work are issued, it will seldom be met with, except by the small, but increasing number of persons who are interested in the study of this obscure and difficult family of plants. We

copy the author's preface, as the best means of introducing the collection to notice.

"The present fasciculus is the first of a series which I propose to issue of the Fungi of Carolina. Nearly all the species have been collected in this State, and mostly in this locality. Each fasciculus will contain a century of species, of which about one-half will be peculiarly American. As materials are obtained, I shall occasionally introduce extra-Carolinian species, which may be new or interesting to American Mycology; the localities of which will be properly noted. Fasc. 2, will follow as soon as sufficient materials are collected for its issue. In the preparation of this work, I must acknowledge my great obligations to the Rev. M. J. Berkeley, of England, and also to my friend, Rev. M. A. Curtis, of this State. To the former, for the examination and determination of a large number of my specimens, Mr. Berkeley's accurate acquaintance with European and intertropical Fungi, and his extensive and well-assorted herbarium, give to his opinions a proper weight of authority in the determination of these obscure plants. To Mr. Curtis, I am indebted for most valuable information respecting the synonymy, derived from an examination of the herbarium of Schweinitz, now in the possession of the Academy of Natural Sciences, Philadelphia. The later American species of Berkeley and Curtis have all been verified by an examination of authentic specimens."

"Black Oak, South Carolina."

We need only add that the present century makes a neatly bound quarto volume; that the specimens are good and sound, and are generally supplied in sufficient quantity; in which respect it compares well with the celebrated *Stirpes Cryptogamici of Mougeot.*

Collections of this kind, authentically named, are truly needful in studying the lower Cryptogamic tribes, and the Fungi in particular; and this work will be especially interesting to European as well as American mycologists, from its exemplifying so many of the species established by Schweinitz, and lately by Messrs. Berkeley and Curtis. This merit it owes mainly to the careful revision of the specimens by our leading and best instructed mycologist, the Rev. Dr. Curtis. It is abundantly evident that the labor and expense bestowed upon the fasciculus, must exceed the price demanded by the publisher, (four dollars,) and that scientific considerations alone can stimulate the indefatigable author to carry on such an undertaking. It is to be hoped that the demand for the work, showing how much it is needed, will induce Mr. Ravenel to continue it. A. G.

3. *Lindley's Folia Orchidacea: an Enumeration of the known species of Orchids.* Part II.—This part contains several small and mostly new genera, viz., *Sarcopodium*, *Sunipia*, *Acrochæne*, *Ione*, and *Erycina* (the latter from Mexico), and six of the twelve subgenera of the large genus *Epidendrum*, including 99 species.

Part III. and IV.—The third part, issued in February last, and the fourth, issued in April, contain the remainder of the genus *Epidendrum*, with an index of the species, 310 in number. Also 8 new genera, all but one monotypical, *Vanda*, of 25 species, and *Luisia* of 11 species.

A. G.

4. *Mohl: Investigation of the question, does Cellulose form the basis of all Vegetable Membranes.* Translated from the *Botanische Zeitung* (Berlin), Vol. 5, 1847, in *Scientific Memoirs, selected from the Transactions of Foreign Academies of Science and from Foreign Journals. Natural History*, (parts 1 and 2,) edited by Henfrey and Huxley, London.—An important memoir, detailing a series of most acute microscopical investigations made under the action of various chemical reagents, and establishing the affirmative of this proposition, or at least, rebutting all the considerations opposed to this view by Mulder and Harting.

The three parts of this new series of *Scientific Memoirs*, the publication of which is now renewed by Taylor and Francis, contain likewise the following botanical papers: viz.,

H. Hoffmann, On the Circulation of Sap in Plants. Also from the *Botanische Zeitung*.

H. Crüger, Organographical Observations on certain Monocotyledoneæ Epigynæ (Trans. from the *Linnæa*, 1849), viz., *Musaceæ*, *Cannaceæ*, *Orchidaceæ*, &c.

W. Hofmeister, On the Development of Zostera, (from *Bot. Zeitung*,) a detailed and admirable paper. An interesting conclusion arrived at, and which Hofmeister generalizes for the whole of Monocotyledons, is, that the so-called *cotyledon* is only the upper portion of an axis of limited growth, from the side of which a bud is developed, which sprouts forth into a secondary axis, forming the future main axis of the plant; thus establishing an analogy between Monocotyledons and vascular Cryptogams, in which the main stem is always a secondary axis, springing laterally from a primary leafless axis. Fully analyzed, however, there seems to be no essential difference between a primary axis and a single cotyledon arrested early in its development.

Wichura, On the Winding (coiling and twisting) *of Leaves*, (from the Regensberg *Flora*.)—An article which is not completed at the close of Part 3. A. G.

5. *Horsfield, Plantæ Javanicæ Rariores, etc.; elab.* J. J. Bennett et R. Brown. Part. IV. London: 1852.—This work is at length completed. The botanical subjects of the concluding part are only five, the notices short, and the observations nearly confined to the plants in question. Where every word is important, we must be thankful for what we can get, but we would gladly have much more, especially since we have been kept so long waiting for it. Dr. Horsfield, our countryman, if we may still call him so after more than half a century of foreign residence, has added a large map of Java, illustrative of his researches, and a detailed account of his explorations in that island, from 1801 to 1819, as well as a Geographical Preface. The botanical observations in this part are wholly the work of Mr. Brown. They principally relate to the order *Phytocreneæ*, now for the first time well defined; to *Cardiopteris*, a plant of obscure affinity, which has two stigmas, very different from each other, the efficient one early developed and deciduous after anthesis; the other (effete) one persistent; and to the *Antidesmeæ*, illustrated by a petaliferous genus, *Bennettia*, which, however, has lately been published by Tulasne under another name. A. G.

6. *Hooker, Species Filicum, being Descriptions of all known Ferns: illustrated with Plates.* London: Pamplin. Part VI, or vol. ii, part II. pp. 61–124, tab. 91–110, 8vo.—This part contains more North American species than any of its predecessors. It is principally occupied with the difficult genus *Cheilanthes*, of which 70 species are described; those of our own country being: *C. microphylla*, Swartz (New Mexico, Wright, No. 823); *C. Wrightii*, Hook. (New Mexico, Wright, No. 823); *C. Alabamensis*, Kunze (*Pteris Alabamensis*, Buckley, in this Journal, 1843); *C. tomentosa*, Link (N. Carol. to New Mexico, Wright, No. 816); *C. Bradburii*, Hook. (Upper Missouri, Bradbury. Texas, Drummond, Lindheimer, fasc. 4, No. 743); *C. vestita*, Swartz? (Missouri, &c., New Mexico, Wright, No. 818); *C. Lindheimeri*, Hook. (Texas, Lindheimer, fasc. 4, No. 744, Wright, No. 817); *C. Fendleri*, Hook. (New Mexico, Fendler, No. 1015); *C. aspera*, Hook. (New Mexico, Wright; probably from Texas);—a large addition to our known species. The other genera are *Cassebeeria*, *Onychium*, and *Hypolepis*. Of the latter we have one species, *H. Californica*, gathered at Santa Barbara, by Coulter and Nuttall. Figures of all these species are given, in a condensed form, but with much neatness. We rejoice to hear that the seventh part of this invaluable work may soon be expected. It must prove still more interesting to North American botanists.

A. G.

7. *N. B. Ward, F. R. S., &c., On the Growth of Plants in closely Glazed Cases.* Second edition. London: Van Voorst, 1852. pp. 143, 12mo.—The first edition of this little treatise, published in 1842, is doubtless well known to many of our readers; and some may remember Mr. Ward's original account of his interesting discovery of a method of growing every sort of plant in the dun atmosphere of the smokiest part of London, published in the Companion to the Botanical Magazine, in 1836. This new edition if reduced in size is increased in interest, and is embellished with tasteful illustrations on wood, several of them exhibiting approved forms of those glazed cases with which the name of our author is inseparably connected. The first chapter, on the natural conditions of plants, their relations to heat, light, and moisture, and the necessity of attending to the particular conditions, or combination of circumstances, under which each species flourishes, is illustrated by ingenious and often novel observations. The second chapter treats of the causes which interfere with the natural conditions of plants in large towns, and gives some idea of the obstacles which prevent the cultivation of even ordinary plants in the open air in London, and to some extent in other large British towns. The third, on the imitation of the natural conditions of plants in closely glazed cases, tell us how a simple incident (the accidental growth of a seedling fern and a grass in a glass bottle, in which the chrysalis of a Sphinx had been buried in some moist mould), carefully and wisely reflected on, taught Mr. Ward how to overcome these obstacles, and thus to surround himself with his favorite plants, in beautiful vegetation, while living in one of the murkiest parts of London, and even to grow with complete success such ferns as the *Trichomanes radicans*, which is utterly uncultivable in any other way. A fourth chapter treats of the conveyance of living plants

on ship-board; which brings to view one of the most important practical applications of Mr. Ward's discovery.

Sir William Hooker states that "the *Wardian cases* have been the means, in the last fifteen years, of introducing more new and valuable plants to our gardens than were imported during the preceding century; and in the character of Domestic Green Houses, i. e., as a means of cultivating plants with success in our parlors, our halls, and our drawing-rooms, they have constituted a new era in horticulture." Formerly only one plant in a thousand survived the voyage from China to England. Recently, availing himself of our author's discovery, Mr. Fortune planted 250 species of plants in these cases in China, and landed 215 of them in England, alive and healthful! The same person lately conveyed in this way 20,000 growing tea-plants, in safety and high health, from Shanghae to the Himalayas. In fact this mode of conveyance is now so universally adopted, and has proved so successful, whenever properly managed, that it is no exaggeration to say that, probably, "there is not a single portion of the civilized world which has not been more or less benefitted by the invention." An indispensable requisite to success in the transmission of living plants by this method is, that the glazed cases should be freely exposed to light. Where this cannot be done, we must be content with the former method, of conveying plants in a passive condition, closely packed in peat-moss,—a plan, however, which is only partially successful in protracted voyages. Two additional and highly interesting chapters treat of the application of the "closed" plan in improving the condition of the poor; and on its probable future applications in comparative researches in vegetable physiology, and even in the treatment of diseases. To these, as to the other topics of this work, no justice can be rendered to our author's suggestions except by lengthened quotations, which the nature of this notice does not admit of. It must suffice to direct attention to this fascinating little volume. Those who read it and who have a true fondness for growing plants, will scarcely be contented without a Ward case, of more or less pretension; which they will find an unfailing source of interest, especially during the long and total suspension of vegetation in our protracted winters. With proper management, and with the requisite amount of light, any plant may thus be cultivated. But we particularly recommend Ferns and *Lycopodia*, of the most delicate kinds, as requiring least care, and as making the prettiest appearance at all seasons. Most of these require little light; although our clear skies afford us this in abundance. So little bituminous coal is consumed, even in our largest cities, that the "fuliginous matter" with which all British towns are begrimed and rendered noxious to vegetation, here interposes no obstacle to rearing plants. Quite unlike England, the principal obstacle to the growth of delicate plants in our houses in winter, and in our grounds in summer, comes from the dryness of the air. For this, the Ward case affords a perfect remedy; as nothing is easier than to furnish a saturated atmosphere for those plants that require it, or to supply and retain the degree of moisture which suits any particular species. A. G.

8. *Infusoria of California.*—Ehrenberg (Monatsb. der K. Pr. Akad. Wiss. Berlin, August, 1852, p. 528) gives the following lists of infusoria from Shasta City and Sacramento River, the latter locality 150 miles above the mouth of Feather River.

Polygastria: 58	Shasta City.	Sacramento River.
Amphora libyca,	•	•
Arcella microstoma,		•
Closterium digitus,	•	
lunula?	•?	
Cocconeis granulata,		•
lineata,		•
mexicana,		•
undulata,		•
Cocconema fusidium,		•
lanceolatum,		•
mexicanum,		•
subtile,		•
———?	•?	
Desmidium Swartzii,	•	
Difflugia assulata?	•	
liostomum,	•	
Discoplea oregonica,		•
! venusta,		•
Euastrum crenulatum,	•	
Eunotia amphioxys,	•	
gibba,	•	•
gibberula,	•	•
granulata,		•
spherula,	•	•
turgida,		•
Fragilaria diophthalma,		•
rhabdosoma,		•
! Gaillonella californica,		•
lævis,		•
———?	•?	
Glœonema paradoxum,		•
Gomphonema Augur,	•	
clavatum,	•	
! giganteum,		•
gracile,		•
herculeanum,		•
minutissimum,		•

	Shasta City.	Sacramento River.
Gomphonema obtusum,		•
Himantidium gracile,	•	
! quaternarium,	•	
! quinarium,	•	
Navicula affinis,	•	
sigma,		•
silicula,		•
———?	•?	
Pinnularia amphioxys,		•
borealis,		•
gastrum,		•
viridis,	•	•?
———?	•?	
Podosphenia pupula?	•?	
Stauroneis anceps,		•
Stauroptera ———?	•?	
Surirella microcora,		•?
Synedra acuta,	•	•
entomon,		•
fasciculata,	•	
ulna,		•
Phytolitharia: 15		
Amphidiscus obtusus,		•
Lithostylidium angulatum,	•	
biconcavum,	•	•
clavatum,		•
crenulatum,	•	•
denticulatum,	•	•
lævе,		•
quadratum,		•
rude,	•	•
securis,		•
sevra,	•	•
Spongolithis acicularis,		•
tracheotyla,		•
ventricosa,		•

They are all freshwater forms; and out of them all, there are only five new species (those indicated by an interjection), descriptions of which are published in the paper from which we cite.

9. *Recent Researches of Prof. Agassiz.*—Prof. Agasssiz has recently made a rapid tour from Charleston, S. Carolina, through Alabama, Mississippi, and Louisiana, thence up the Mississippi to St. Louis, Chicago, and along by the Great Lakes to New York and Massachusetts. In a recent letter from him, addressed to J. D. Dana, dated Cambridge, June 9th, he mentions the following as some of the results of his tour.

"I have been successful in collecting specimens, especially fishes, of which I have brought home not less than *sixty* new species, mostly from the great southern and western rivers. Some of these are particularly interesting. I would mention foremost a new genus, which I

shall call *Chologaster*, very similar in general appearance to the blind fish of the Mammoth Cave, though provided with eyes; it has like Amblyopsis *the anal aperture* far advanced *under the throat*, but is *entirely deprived of ventral fins;* a very strange and unexpected combination of characters. I know but one species, Ch. cornutus, *Ag.* It is a small fish scarcely three inches long, living in the ditches of the rice fields in South Carolina. I derive its specific name from the singular form of the snout, which has two hornlike projections above.

The family of Cyprinodonts has received the most numerous additions, and among them there are again new combinations of characters. Several years ago I noticed two species of a new genus which I would call *Heterandria*, from the great difference observed between the two sexes, the males having the ventral fins near the pectorals in about the same position as in the *Thoracic* fishes, while the females have those fins in the middle of the belly as in the *Abdominals*. Of this genus I have observed several new species. They all live in dense schools in shallow waters. Another type, *Zygonectes*, presents no such sexual differences, and differs also in its habits. These fishes are constantly seen swimming on the top of the water *in pairs*, whence their name. I have found half a dozen new species of this genus.

You may remember the remarkable genus Mollinesia described by Lesueur from specimens obtained from Lake Ponchartrain and from Florida. If you do not, pray look for the figures in the Journal of the Acad. of Nat. Sci., vol. 2, to appreciate the facts here mentioned. From its structure and from the sexual differences observed among other Cyprinodonts, I have long entertained the opinion that this genus had been established upon the males of Pœcilia mutilineata also described by Lesueur (same Journal), and both admitted as distinct in the great natural history of fishes by Cuvier and Valenciennes. Having found both together in all the Gulf States, I have watched them carefully, and in Mobile as well as in New Orleans, I have seen them day after day in copulation during the months of April and May; so that their specific identity is now an established fact. I have caught hundreds of them and found all the Pœcilias to be females and all the Mollinesias males; and what is further very interesting, the females are viviparous. I have been able to trace their whole embryonic development in the body of the mother, in selecting specimens in different stages of gestation.

I do not remember whether I have already mentioned to you the existence in the United States of two families of fishes not before observed in our waters, one the *Myxinoids* with one species from Eastport in Maine, collected by W. Stimpson, the other the *Erythrinoids* of Valenciennes, or *Characini* without adipose fin of T. Müller, of which a new genus occurs in the freshwaters of our northern and middle as well as western States, with half a dozen species, some of which have been unfortunately described as Leuciscus, Fundulus and Hydrargyra, with which genera they have no affinity, while other new ones have been discovered by Professor Baird and myself. I shall call this genus *Melanura*, from the singular black mark which all species show upon the tail. But I would tire you were I to go on with my ichthyological remarks, even if I should limit myself to enumerating new genera, for I have many more of these.

I will close this long letter with one observation upon Crustacea, which may have a more immediate interest for you, if you have not yet noticed the fact yourself. On my return from Florida two years ago, I noticed among many specimens of Lupa dicantha, one in which the tail presented a triangular form intermediate between that of the male and that of the female. Unable to ascertain from a single specimen whether it was a mere variety or perhaps an improperly developed female, I awaited another opportunity for a fuller investigation, which the market of Charleston, S. C. afforded largely during the latter part of February last, when I ascertained that that form was at times as common in the market as either the males or the females, and upon careful anatomical examination, I satisfied myself farther, that these specimens *are entirely deprived of internal sexual organs*, though slight indications of the openings of the sexual organs, entirely closed up by calcareous matter, clearly indicated that they are imperfectly developed females, a kind of neuters among crabs, the great number of which leads to the supposition that they are not without function in the general economy of these animals. The tail is soldered to the carapace, the last joints only at which the alimentary canal terminates, being moveable. At the same time males and females were dissected, and showed the sexual organs in that fulness which precedes copulation. Looking afterwards for similar conditions in other species, I found in the collection of Professor L. Gibbes, specimens of Lupa cribraria, and of L. Sayi with the same conformation of their tail. * * * *

I cannot help returning to my fishes to say, that I have now *twenty species* of Lepidosteus from the United States in my collection, a good foundation upon which to base a revision of the fossil fishes. I could not say how many other new things I have collected, for I have not yet unpacked half my packages."

V. Astronomy.

1. *New Planets*, (24).—On the evening of the 5th of April, 1853, Professor Gasparis of Naples, discovered a new planet in the constellation *Leo*, in R.A. about $11^h\ 4^m$ and Decl. 6° 50′. It resembles a star of the 12th magnitude. The following elements were computed by Messrs. Förster and Krüger of Bonn, from observations at Naples, April 6 and 13, and Bonn, April 27 and May 10.

Epoch, 1853, May 10·431400, M. T. Berlin.

Mean anomaly,	341° 52′ 26″·3	Mean Eqx.
Long. asc. node,	32 26 35 ·3	1853·0.
" perihelion,	213 32 44 ·2	
Angle between perih. and node,	181 6 8 ·9	
Inclination,	0 53 46 ·8	
Angle of excentricity,	14 21 14 ·2	
Log. of semi-axis major,	0·561038	
" mean daily motion,	2·708450	

2. (25)—On the 6th of April, M. Chacornac, at Marseilles, discovered another planet which M. Valz proposes to call *Phocæa*. It appears like a star of the 9th magnitude, and of a bluish color. Comparison

with 27363 Lalande, (*a*) and Argelander, zone 16, No. 205 (*b*) gave the following positions;—

1853.	Marseilles M. T.	R. A.	Decl.
April 6,	$15^h\ 40^m$	$a+04^m\ 11^s{\cdot}5$	$a+11'\ 2''$
" 8,	11 58	$b+\ 1\ 57$	$b+\ 4\ 22$

3. (26)—Mr. Luther of the Observatory at Bilk, discovered another planet—the twenty-sixth of the asteroidal group—on the 5th of May. It is of the 10·11 magnitude. The following observed places are given;—

1853.	Bilk, M. T.	R. A.	Decl.
May 5,	$13^h\ 0^m$	$207°\ 40'$	$-10°\ 15'$
" 14,	11 52	206 3	− 9 57

4. *First Comet of* 1853, (Astron. Journal.)—In the last number of this Journal was mentioned the discovery of a comet on the 8th of March, by Mr. G. W. Tuttle, assistant at Harvard College Observatory. This comet was first seen by Professor Secchi, at the Observatory of the Collegio Romano, on the 6th of March. It was discovered independently also by Schweizer, at Moscow on the 8th, and by Dr. Hartwig on the 10th. There is some reason for supposing this comet to be identical with that of 1664. The following elements were computed by Mr. C. W. Tuttle from the observations at Cambridge, of March 10, 18 and 29.

T. 1853, Feb. 24·165622, M. T. Greenwich.

Long. of perihelion, - -	$153°\ 37'\ 58''$	Appar. Eqx.
" asc. node, - -	69 15 30	1853, Mar. 18.
Inclination, - - -	20 8 11	
Log. of perihelion dist., -	0·037938	

Motion retrogade.

5. *Second Comet of* 1853, (Astr. Jour.)—Professor Schweitzer, at Moscow, discovered a comet on the 4th of April 1853, which he describes as "small and round, about 3′ in diameter, and without a tail." He gives the following places;—

1853.	Moscow, M. T.	R. A.	Decl.
April 4,	$15^h\ 0^m$	$20^h\ 3^m\ 20^s$	$+13°\ 4'$
" 5,	14 0	20 4 25	+13 1

VI. Miscellaneous Intelligence.

1. *Notes on the Almaden Mine, California*, in a letter from T. S. Hart, dated San Jose, Nov. 26th, 1852.—We left San José at 8 o'clock in the morning in a stage which plies daily, and after a ride of an hour and a half over a most excellent road and through as beautiful and fertile a valley as the eye ever beheld, we arrived at the beautiful village of Almaden, distant twelve miles from San José. It is situated on the bank of a small stream of the purest water I have seen in California. There is an excellent soda spring in the midst of the village, the water of which is considered as good as the Congress or Saratoga water. There is a large bakery near it, and they use the water in mixing up their bread, and certainly make as fine bread as I ever have eaten.

The works are much more extensive than I expected to find them. We called upon the superintendant, Mr. John Young, who treated us very courteously. The buildings are nearly all new, the old ones having been mostly removed. The loads of ore are brought down by the road to a level with the top of the furnace where it is separated into coarser and finer pieces. The process of extracting the metal from the ore is very simple. The ore is placed in the furnaces where a gentle and regular heat is applied. As it diffuses itself through the ore the quicksilver contained in it sublimes and is afterwards condensed and falls by its own weight, trickles down and out at little pipes leading from the bottom of the chambers of the furnace and empties into vessels so situated as to receive it. From these pipes we saw the quicksilver falling more or less rapidly in large drops. In one vessel there must have been from 15 to 20 gallons of quicksilver. Mr. Young informs me that they manufacture about 1000 flasks per month, each flask containing 75 pounds, making 75,000 pounds per month. The flasks are all of wrought iron. The time occupied in filling the furnace and extracting all the metal from a furnace full of ore is about one week. When this is accomplished, the furnace is opened that the mass of rock may be removed to make way for another batch of ore. When these ovens are first broken open they have to be very careful not to approach them too soon, as the air is charged with the quicksilver escaping in the form of vapor, and if a person breathes it he is sure to be salivated.

After examining the works and the different processes we visited the mines, which are one and a fourth miles from the works. We procured an order from the superintendant for that purpose, as no person would be admitted without one. We started up a beautiful road cut in the side of the mountain, the road being about 25 feet wide, and rising on an angle of about 20 (?) degrees. About half way up we came to a locality of sulphate of lime, from which some fine specimens have been taken. (I also found some specimens of fluor spar and chalcedony near the soda spring.) After a fatiguing journey we reached the entrance to the mine and handing our order for admission to the manager, who appeared to be a very gentlemanly man, we were furnished with a guide. We entered a car which was pushed by our guide into the tunnel, which is a most substantial and masterly piece of workmanship, being arched over in a most thorough manner; it is about 900 feet in length, 10 feet wide, and 10 feet high, with a rail road extending the entire length. The tunnel is some 300 feet below the former outlet near the top of the mountain. We were now each furnished with a torch with which each must enlighten his own way. We were now in the bowels of the mountain with 350 feet of earth over our heads. The mouth of the tunnel did not appear as large as a man's head.

We soon commenced our explorations from chamber to chamber, which appeared to extend in a most intricate manner in almost every direction. Sometimes we descended a pole almost perpendicular for fifty feet, with merely little notches cut for the toes, and at other times ascended them. We finally came where the miners were at work; we heard the ringing of the drills and the strokes of the hammer,

and on approaching nearer we could hear the measured groan or grunt with which they accompany each stroke that they make, and when I was convinced that it did not indicate pain, as its doleful sound led me to think, it became so ludicrous that I burst out into a hearty laugh. The miners are all Mexicans and have been brought up to it from their infancy. Here was the richest *lead* they had in the mine; I obtained a number of specimens from it. They estimate that the chambers or avenues in a continuous line would extend a mile and a quarter; several have been abandoned on account of the danger of working in them.

We finally ascended to the upper outlet or that which was first executed by the Indians, who must have begun at a very early date, as they had penetrated the mountain more than sixty feet, which must have been a most arduous task with the rude stone implements they worked with. They sought the vermillion to paint themselves with. They must at times have met with terrible catastrophies; one chamber was pointed out which contained a large amount of human bones buried beneath the rock which had evidently caved in upon them where they had made their excavations too wide. Having got out into daylight once more, we found ourselves near the top of the mountain, the view from which repaid us richly for our laborious ascent. There was spread out before us a vast extent of country, including the whole range of the valley of San José, and the bay with the land bordering it on either side, as far up as San Francisco on the west, and a point opposite to it on the east. Twelve miles from us on the plain was the town of San José, a little to the left the town of Santa Clara, and still further on the village of Alviso, and the Mission of San José on the table land in the distance. This country is so rich and fertile that when its agricultural merits are fully developed and brought to bear, it will feed and maintain all the population of California.

2. *Infusoria.*—In the American Journal of Science for March, 1845, mention is made of an infusorial earth supposed to have been brought from the Bermuda Islands. The history of the specimen there given is that it was received from M. Tuomey, Esq. of Petersburg, Va., labelled "Tripoli from Bermuda;" that he had received it so labelled from some mineralogical correspondent, and did not doubt that it came from Bermuda. No other specimen has ever been procured, and all efforts to discover the locality have hitherto been unsuccessful. Inquiry at the Bermuda Islands has made it quite certain that this earth does not exist there. On this ground and because of the identity of many of the species of infusorial shells found in this specimen, with those found in the infusorial beds of Virginia and Maryland, it is conjectured that it came from the Bermuda Hundred near Richmond, Va. The discovery of the locality of this earth is a matter of considerable scientific interest, for in the abundance, novelty, variety and beauty of the infusorial forms which it contains it is unparalled. The specimen is very white, friable and light, and consists almost wholly of infusorial remains. Will not some naturalist near the Bermuda Hundred make a reconnoisance of that place and report to the editors of this Journal, and if successful forward a box of specimens?

3. *Abstract of a Meteorological Journal kept at Beloit College, Beloit, Wis., for the year* 1852.—Lat. 42° 30′ 23″ N.; Long. 12° 03′ 20″ W. from Washington; elevation above Lake Michigan, 172 feet—above the Ocean, 750 feet; by S. P. Lathrop, M.D., Professor of Chemistry and Natural History.

MONTHS.	BAROMETER.			THERMOMETER.			Clearn's of sky.*	Prevailing winds.	Inches rain & melted snow.
	Max.	Min.	Mean.	Max.	Min.	Mean			
January,	29·66	28·67	29·395	58	−18	21·44	4·32	N.W. & S.W.	3·39
February,	29·73	28·24	29·155	48	0	30·26	5·70	N.W. & S.E.	·84
March,	29·80	28·40	29·121	72	4	34·00	4·22	N.W. & N.	6·75
April,	29·38	28·54	29·501	72	20	43·83	4·95	N. & N.W.	3·99
May,	29·56	28·72	29·240	85	35	60·61	6·85	S.E. & S.W.	4·75
June,	29·58	28·87	29·258	89	43	68·13	6·73	S.W. & N.W.	2·15
July,	29·56	29·07	29·300	92	51	74·16	6·70	N., S., & S.E.	3·49
August,	29·52	29·03	29·346	93	52	70·42	7·10	N.E. & S.	1·02
September,	29·58	28·40	29·314	88	37	58·58	6·40	N. & S.	2·91
October,	29·56	28·90	29·258	76	32	51·25	4·40	N. & S.	4·98
November,	29·67	28·66	29·214	50	11	31·83	4·15	S.W., N. & N.W.	2·43
December,	29·56	18·47	29·254	55	− 4	24·55	3·63	S.W. & S.	3·30
Year.	29·597	28·665	29·265	93	−18	47·421	5·51	N., N.W. & S.W.	40·00

The mean temperature for the past year is 47·421, being a medium of the two previous years.

The mean temperature of the winter months of 1851–52 is 24·600, being a lower temperature than that of either of the two previous years by about 2°; the temperature for the spring months is 46·146, being 0·554 lower than that of last year, and 2°·966 higher than that of the year previous to the last. The temperature of the summer months is 70°·570, being 2°·930 higher than that of the summer months of last year and 0°·93 lower than that of the year 1850. The temperature of the autumnal months is 47°·22, being 3°·23 lower than that of the last year, and 2°·35 lower than that of the year before the last.

The average density of the atmosphere, as indicated by the barometer, is 29·265 inches, being ·074 inches lower than for the last year, and ·005 inches lower than for the year 1850.

The amount of rain and melted snow for the year is 40 inches, being 15·90 inches less than for the last year, and 11·24 inches less than for the year 1850. This amount, with the exception of the months of February and March, was quite equally distributed through the year.

The amount of snow which fell in the winter of 1851–2 was more than in either of the two previous years, being 30 inches. This amount was nearly equally distributed through the winter with the exceptions above mentioned, February having only 1·5 inches while March had 9 inches.

The crops of the last year were universally *good* crops, though not remarkable for their *great* yield. The grass was slightly affected by the dry weather in the latter part of June and late crops by the dry weather in the latter part of August, but none very seriously. Our prairie soil seems remarkable for its retention of moisture and the small

* Clearness of sky is indicated by numbers from 1 to 10; perfectly clear is marked 10.

extent to which crops upon it suffer in a *dry time* compared with that which they experience on most of the soils of New England.

The presence of a stratum of fine red clay which so generally underlies the surface-soil appears of great value in imparting this property to our soil.

The *chinch-bug* which made its appearance once in some districts two years since and was not seen last year, appeared again the past year in great numbers, doing, as some think, much damage to the wheat and some other crops.

The prevailing winds were north and northwest.

CALENDAR.—*Jan.* 19th, Splendid auroral arch from 8½ to 10 P. M.

Feb. 18th, Aurora at 10 P. M.

March 7th, Wild geese seen; 8th, thunder-storm; 10th, meadow lark singing; 11th, robins singing; 12th, star of Bethlehem up; 17th, aurora with streamers.

April 2d, Anemone in flower, wild gooseberry in leaf; 14th, wild pigeons seen, Missouri currant in leaf; 21st, ground ivy in flower; 22nd, arched aurora at 9 P. M., bloodroot in flower; 29th, rainbow in the west at 5½ A. M.

May 1st, Dielytra cucullaria, dwarf iris in flower; 4th, viola cucullata in flower; 7th, Missouri currant in flower; 8th, English cherry in flower; 10th, spring beauty and wild plum in flower; 12th, burr oak, hickory and horse-chestnut in leaf, peach and pear in blossom; 17th, Dodecatheon media in flower, black and white oak in leaf; 18th, splendid aurora from 9¾ to 11 P. M.; 22nd, blue eyed grass in flower; 24th, lilac, and fly honeysuckle in flower; 29th, snowball in flower; 31st, lady's slipper.

June, Locust in blossom; 15th, Lobelia spicata and Anemone pennsylvanica in flower; 19th, Rudbeckia rosa; 22nd, Trillium philadelphicum in flower; 23d, hairbell and yellow water lily in flower.

July 21st, Hottest day in the year, the average of the thermometer for the day being 82°·50.

Nov. 6th, First snow.

Dec. 17th, Aurora; 21st, coldest day, average of thermometer 4°50.

4. *Remarkable Clouds*, (from a letter to the Editors, dated S. Bridgewater, Mass., June 13th, 1853.)—The following phenomenon was observed at S. Bridgewater, Mass., June 5th, at 5 P. M. A slight species of cloud completely lined off the heavens into great circles, which, by applying the compass, I found to verge to points of meeting at the north and south, situated precisely in the magnetic meridian. These circles were very regularly arranged at intervals of 2½ to 3°, and were remarkably uniform in their appearance, both in regard to density and width; the width near the equinoctial being about one degree, and diminishing toward the poles.

The general density of these curvilinear clouds was *less* toward the south than toward the north, and some of them were discontinuous below the line of 10 to 15° above the horizon. In the north the continuity appeared to be complete, and their approach to the point of meeting did not obliterate their individuality; which was manifested in light lines upon a slightly dusky ground, the *general* ground of the heavens at a distance from the poles being at the time a dusky blue.

A beautiful accompaniment to this phenomenon was a halo around the sun, curiously intercepted by the intervals between these regular curvilinear clouds. The previous portion of the day had been quite clear; the wind blowing lightly from the point east by north, and remaining unaltered during the continuance of the phenomenon, which was about one hour. The course of the wind, it will be remarked, was at a right angle with the magnetic meridian. E. C.

5. *Tooth of Getalodus Ohioensis;* by Prof. J. M. SAFFORD, Lebanon, Tenn.—At the Albany meeting of the American Association for the Advancement of Science, held in August, 1851, Mr. J. W. Foster spoke of the occurrence of fossil teeth in the coal measures of Cambridge, Ohio. The year before, I had been fortunate enough to discover, near Cambridge, a perfect specimen of one of these teeth. It was imbedded in limestone. At the Albany meeting it was shown to Prof. Agassiz, who pronounced it at once a new species of Getalodus. Within a few weeks I have succeeded in detaching it from the limestone. Two views of the specimen are presented. The cutting edge still retains its enamel and is finely serrated. I have named the species, provisionally, G. Ohioensis.

1. 2.

It is to be hoped that the locality will afford other characteristic specimens.

6. *Products of the Swedish Mines in* 1849, (Ann. des Mines, [5] i, 125; Annual Report of the School of Mines of Sweden.)—The whole yield of the Swedish iron mines in 1849 was 1,185,300 metric quintals of cast iron, and 868,805 of forged iron.* The exports were as follows, North America taking the second place.

	Metric quintals.
Great Britain and Ireland, . . .	241,680
North America, ...	178,776
Denmark, ...	65,685
Portugal, Madeira, Azores, etc., .	44,530
France, ...	41,397
Different countries not enumerated, .	175,942
	748,010

7. *Quarterly Journal of Microscopical Science: On the Application of Photography to the Representation of Microscopic Objects.*—The excellent number of the Microscopic Journal, recently issued, derives special interest from the papers it contains on the use of photography with the microscope. The process has been attempted with

* The metric quintal may be reduced to tons by multiplying by 1·971.

partial success by different photographers; but we have here an example of its successful application, by J. Delves, Esq., and an illustrating plate (pl. 7,) of great beauty and perfection, the objects figured on which (one the spiracle and trachea of the silkworm, the other, the proboscis of the fly, showing the divided absorbent tubes,) are magnified respectively 60 and 180 diameters. The following is the account by Mr. Delves of his process.

"The only arrangement necessary for the purpose is the addition to the microscope of a dark chamber, similar to that of the camera obscura, having at one end an aperture for the insertion of the eye-piece end of the compound body, and at the other a groove for carrying the ground-glass plate.

This dark chamber should not exceed 24 inches in length (the size which I have found best to adopt): if extended beyond this, the pencil of light transmitted by the object-glass is diffused over too large a surface, and a faint and unsatisfactory picture is the result. The specimens exhibited were taken at this distance, which has the additional advantage of producing a picture, in size very nearly equal to the object as seen in the microscope. The eye-piece must be removed from the compound body, and the object (being well illuminated by reflection from the concave mirror) must be adjusted and focused upon the ground-glass plate. In the production of positive pictures a slight difficulty here arises, dependent upon the 'over-correction' of the object-glass. The effect of this 'over-correction' is to project the blue rays of light beyond the other rays of the spectrum, and as the chemical properties of light reside in the violet and blue rays, it becomes necessary that the plane of the sensitive plate should coincide with the foci of these rays, and it must therefore be placed beyond the surface at which the best definition is seen; this amounts to some distance with the lower combinations, and decreases with the increase of magnifying power.

For the production of *negative* pictures the ordinary illumination is not sufficient, and recourse must be had to the sunbeam, which should be reflected upon the object by the plane mirror when powers are used not exceeding the quarter of an inch combination. It is not necessary here (when producing negatives by the sunbeam) to allow for the 'over-correction' of the object-glass, but merely to focus the object carefully upon the ground-glass plate.

With regard to the time required for the production of these photographs, unfortunately no precise rules can be given, since it must vary with the sensitiveness of the materials employed. The larger group exhibited was produced by the 'one-inch object-glass,' and the time given varied from ten seconds to one minute. The smaller group representing 'scales of Lepisma saccharina by the quarter inch and one-eight inch glasses, was taken with a more sensitive collodion; and the time from ten to fifteen seconds.'

In the production of negative pictures (from which the paper specimens were obtained) a moment's exposure to the sunbeam is sufficient when using the lowest powers, and with the highest I have varied the time from five to ten seconds.

In conclusion, I beg to submit this method which I have found so simple and successful, in the hope that the communication may be

the means of directing attention to a subject both useful and interesting, and in the confidence that most satisfactory results will yet be obtained."

There are also in this number of the Microscopical Journal, two other papers on this subject, one by George Shadbolt, Esq., and the other by Samuel Highley, junior, both full of important details, and the latter very complete in its illustrations. We cite the former, referring to that Journal for the valuable paper of Mr. Highley.

"As it is not my intention to enter into particulars of the rise and progress of this art as connected with the microscope, I will only observe that the earliest microscopic photographs which I had the pleasure of seeing were some Daguerreotypes executed by Mr. Richard Hodgson by the aid of the *direct rays of the sun;* and for these I believe he is entitled to claim the honor of having been the first to produce a picture of this kind.

But however beautiful the sharpness and detail of pictures upon metallic plates, there are many causes to confine the practice of the Daguerreotype art within such very contracted limits as to render it of little use to the microscopist; whereas the increasing beauty and sensitiveness of the Collodion process renders it a much more encouraging medium for further experiment in this direction, besides offering the additional inducement of enabling one to transmit duplicates upon paper to others engaged in similar observations at a distant place, by which comparisons of much value can be made, and without the expense and inconvenience of having to execute duplicates from the objects themselves.

As it happens that the great majority of the followers of microscopic science are mostly engaged in professional or other business pursuits during the day-time, and in most instances at a distance from home, it occurred to me that if *artificial light* could be made to act sufficiently energetically to produce microscopic pictures, it would be a very considerable advantage to a large number of persons who would otherwise not be able to avail themselves of so excellent an assistant as the photographic art; and further, that to render it practically useful, it must be done by an illumination *readily accessible* and *inexpensive;* I therefore determined to institute a series of experiments with this end in view, and having availed myself of all the hints thrown out by Mr. Delves, Mr. Hogg, and others, at the Microscopical meeting in October, after very many failures and no small amount of trouble, I at length was fortunate enough to meet with success as, in my opinion, to offer very considerable encouragement for further operations with a reasonable hope of a really useful result; and at the meeting of the Microscopical Society in November last I had the pleasure of exhibiting a picture of a Fly's Proboscis, produced by the aid of a very small camphene lamp. In the hope of enlisting more laborers in this field of research, I purpose detailing the 'modus operandi' which I have found most successful; trusting that, in a short time, the little seed thus sown may bring forth an abundant harvest.

I would premise that I do not advocate photography in microscopic science as a rival that will *supersede* the draughtsman, except in certain cases; and although it may in very many instances do so; it will

most assuredly *make* much more work than it takes away from those who follow the occupation of a microscopic artist.

When the object to be delineated is flat and moderately thin, as compared with the necessary power in use, a very excellent picture may be produced without any aid from the limner; but where the object is not so formed—although when under microscopic examination the mind can readily acquire a correct knowledge of the form by focusing up and down—it is evident that from the very construction of a good objective a *picture* can only be obtained in *one plane at a time*, and it will then be necessary to take several pictures in different planes, and call in the artist's aid to unite the productions. The immense amount of time and labor that can be thus saved in delineating subjects of an elaborate character can only be appreciated by those who have attempted the production of objects of this class.

It is scarcely necessary to enter into a preliminary explanation on the photographic phenemona, as it is of very little use for an entire novice in the practice of this art to commence upon microscopic subjects; I shall, therefore, presume that I am addressing those who understand the general principles of photography, and shall therefore commence with

The Arrangement of the Apparatus.—Place the microscope with the body in a horizontal position, and screw on the objective to be used, and fix the object in its proper position on the object-plate of the stage by pressing down the sliding spring-piece. Turn the mirror aside or remove it altogether, and having taken out the eye-piece, insert into the body a tube of brown paper *lined with black velvet*, in order to prevent the slightest reflection from the sides, which would infallibly spoil every picture if allowed to operate. The lens should then be removed from an ordinary photographic camera, and the latter elevated so as to bring its centre in an exact line with the axis of the microscope body, which must have its eyepiece-end inserted in the place left vacant by the removal of the camera lens, and that portion of the opening not filled up by the body may be rendered impervious to light by a piece of black cloth, velvet, or other similar material.

The lighted lamp must next be brought, so that the center of the flame is in the axis of the instrument, and its distance must depend upon the focus of the lens used to concentrate the light, for which purpose an ordinary convex lens of $2\frac{1}{2}$ to 3 inches diameter, with its flat side towards the lamp, is perhaps as useful as any, provided a second plano-convex lens of that focus is interposed near the object to concentrate the light still more strongly. It is not necessary, or even desirable, that an *image* should be formed of the source of light, and consequently the spherical aberration in such an arrangement as recommended is *not* detrimental, and *may* not be advantageous.

The ground glass screen to receive the image being in its proper place in the camera, the object may be brought to a correct focus in the usual way with the coarse and fine adjustment, and this cannot be done too accurately; in fact, for delicate objects, a means of magnifying the image is absolutely requisite, and for this purpose a positive eye-piece, placed in contact with ground glass, is perhaps best.

Most achromatic objectives of the best construction are slightly over-corrected (as it is termed) for color, in order to compensate for a small amount of under correction in the eye-piece, that is to say the violet and blue rays of the spectrum are therefore projected beyond the red ones.

As it is ascertained that most of the photogenic or actinic rays are located in the violet end of the spectrum, it follows that with such a lens as is used for the microscope, the *chemical focus* will be somewhat more distant from the object than the visual focus, and it therefore becomes necessary to make some allowance for this difference.

This may be done in two ways, either by placing the sensitive plate somewhat farther off than the ground glass on which the image is received, or by altering the focus by the fine adjustment; the latter being the plan I prefer, as I find it much more accurate.

The *amount* of difference between the foci probably varies in every objective, even apparently of the same make, and can only be ascertained by direct experiment; but the following may be some guide to those who wish to experiment upon the subject.

An *inch-and-a-half* objective of Smith and Beck's make required to be *withdrawn from* the object after the correct visual focus is ascertained 1-50th of an inch, or *two turns* of *their* fine adjustment.

A *two-thirds of an inch* object-glass of same make wants a withdrawal of 1-200th of an inch, or ½ a turn of the fine adjustment.

A 4-10ths of an inch, about 2 divisions, or 1-1000th of an inch farther off. With the 1-4th, and higher powers, the difference between the foci is so minute that it is *practically* unimportant. The above differences are those actually existing in my own objectives, but, as before intimated, it does not follow that they will be correct for others even of the same makers.

Having arranged the apparatus, focused, and made the requisite adjustment for chemical focus, the ground glass may be removed, and the sensitive plate placed in its stead.

As in all other photographic processes, the time of exposure must be varied according to the power in use, the nature of the object to be taken, and the amount of illumination, to which, must be added in the present instance, the *medium in which* the object is mounted: but from 1 *to* 10 *minutes*' exposure is generally requisite. An explanation of the last named disturbing cause may probably be found in the beautiful discovery of Professor Stokes of the property possessed by certain transparent media of arresting the chemical rays.

Any account of the preparation of the collodion, &c. &c. would be more fitted for a work on photography, and would render the present paper much too long: moreover there is an abundance of information on photographic manipulatory details readily accessible in numerous publications, such as Mr. Robert Hunt's Manual, Mr. Bingham's, Mr. Archer's, Mr. Horne's, Mr. Hennah's, &c. &c. There are, however, one or two points which it is as well to allude to. If the film of a collodion picture be examined by the microscope, some specimens will present an appearance very much resembling condensed cellular tissue, such as that seen in the cuticle of leaves, being apparently made up of flattened irregular hexagonal cells; while others seem to consist of an entirely structureless amorphous mass; the latter sort of collodion is most suitable for microscopic purposes.

The final fixation of the picture by removal of the iodid of silver has a singular influence upon the result according to the method employed, and advantage may be taken of this in order to improve the effect according as it is desired to produce glass positives or negatives; for though all collodion pictures partake of *both* characters, one of the two *should* always be predominant.

Of course a negative is most useful, because the drawings can be multiplied upon paper almost ad infinitum, but for certain objects the amount of detail when *very delicate* is inconceivably better shown upon glass than upon paper. If then a negative picture be desired, it is best to develop with the pyrogallic acid solution, and *fix* with a solution of hyposulphite of soda; but if, on the contrary, a positive picture is the desideratum, the effect will be infinitely better by fixing with a bath of the following, viz.:—

Cyanid of potassium,	- -	1½ drams.
Water, .	- - -	1 pint.
Nitrate of silver,	- - -	15 grains.

The cyanid to be dissolved in the water, and the crystals of nitrate of silver added, which immediately cause a curdy precipitate, but this is quickly redissolved, and the whole becomes quite translucent.

By this method of fixing, the *whites* are very much purer and brighter than when the hyposulphite is used, but the pictures do not answer so well for printing from. A still further intensity of the whites may be produced by *developing* the picture with a solution of the *proto-sulphate of iron*, instead of the pyrogallic acid, and afterwards fixing with the cyanid solution; there are, however, certain difficulties of manipulation to overcome. The solution is made as follows:—

Proto-sulphate of iron in crystals,	- -	1 oz.
Water,	- - - by measure	10 oz.
Sulphuric acid,	- - - "	1 oz.

This is best used by placing in a *glass* bath and *totally immersing* the plate, which should be withdrawn *the moment* the picture is perfectly developed, which will be in from 15 to 60 seconds, and it ought to be instantly plunged into a bath of plain water sufficiently copious to dilute the adherent moisture very considerably. The object of having the bath of glass, is in order to see the development of the picture, as every *second* it remains after it is fully produced, is to the detriment thereof, by causing a sort of fogginess to appear all over it.

When developed with the protosulphate of iron, the pictures may be exposed to direct daylight before the final fixing, without injury, in fact with positive benefit, according to Mr. Martin.

The causes most frequently operating to prevent the success of the process are, *first*, want of attention to the proper illumination; it is to this point more than any other that the utmost attention should be paid, and I feel confident that by well concerted measures to attain this requisite, we shall eventually be able to obtain pictures in a tithe of the time now necessary; in the second place failures more often occur from *over exposure* than from being in too short a time; thirdly, want of allowance for difference of visual and chemical foci."

8. *On optical figures produced by the disintegrated surfaces of crystals;* by Sir DAVID BREWSTER, (Phil. Mag. [4] v, 16.)—This paper describes and illustrates by figures, various optical figures obtained by the reflection of a luminous point from the disintegrated surface of a crystal. The examination of certain crystals of topaz suggested the investigation. The surfaces may be either naturally disintegrated or through the action of solvents.

An octahedron of alum, when perfect, gives a single reflection of a candle from one of its surfaces. But on immersing it for an instant in water and then drying it, there are three pencils of light diverging at angles of 120°, but not meeting at center; after a second immersion, three small images of the candle, 1, 2, 3, appear at intermediate points, around the center; and on a third immersion there is another set of three, and then still another, the previous ones changing also their forms. By placing the crystal again in a strong solution of alum, for an instant only, the particles were re-deposited, and exactly filled out what had been removed, so that the surface gave, as at first, but one image. Brewster varied the experiments in many ways, and made similar trials with fluor spar, carbonate of lime, etc., and developed the most wonderful results.

Different solvents were found to produce different optical figures. Alcohol and muriatic acid act on alum differently from water. Other remarkable changes were produced by immersing crystals in saturated solutions of salts.

Mechanical abrasion by means of a piece of sandstone, hone or file, produced in a rude manner the figures given by solution; but what was very remarkable, the figure had a reversed position, or was like what solution would produce on the opposite face.

The power of producing the optical figures may be transferred from the crystal surface to wax or isinglass; and the impressions on isinglass, enable us to see the figure by transmitted light and observe its form and dimensions with great accuracy.

9. *Aurora Borealis.*—Mr. W. J. M. RANKINE announces (in Phil. Mag., [4] iv, 452) that he has on several nights examined the light of the aurora borealis with a Nichol's prism, and has never detected any trace of polarization. The same light reflected from the surface of a river was polarized, showing that his failing to detect polarization in the direct light of the aurora was not owing to its faintness. This fact is adverse to the idea that the light of the aurora is reflected light.

10. *Meteoric stone of Lixna.*—EICHWALD (Pogg. Ann., lxxxv, 574) has determined the composition of this ash gray and fine granular meteoric stone as follows:—Nickeliferous iron ·22 (iron 20, nickel 2), sulphuret of iron 9·5 (iron 6, sulphur 4·5), silica 33·2, protoxyd of iron 22·0, magnesia 10·8, alumina 1·3, lime with trace of manganese 0·5, chromium 0·7. The silicates appear to be white round grains of anorthite or labradorite, yellowish brown olivine or garnet, and black augite.

11. *American Association for the Advancement of Science.*—This Association will hold its next annual meeting at Cleveland, Ohio, during the week commencing with the 28th of July. Professor Peirce of Cambridge is the President for the year.

OBITUARY.

Death of Dr. Lewis C. Beck.—This melancholy event occurred at Albany on the 20th of April, 1853, in the 55th year of his age. At the time of his decease, he held the offices of Professor of Chemistry and Natural History at Rutgers College, New Jersey, and Professor of Chemistry in Albany Medical College. Of retiring habits, joined to great industry and devotion to science, his personal character was such as to gain him numerous and attached friends. For several years previous to his decease, his health had been feeble, and his strength apparently failing. His devotion to his duties was however unremitted.

The best memorial of Dr. Beck is a list of his writings, the most important of which are stated below.

A Gazetteer of the States of Illinois and Missouri, &c. Albany, 1823. (This work contains numerous engravings and descriptions of Indian remains, obtained from personal observation.)

*New York Medical and Physical Journal.**

Vol. 1. Facts relative to a disease generally known as *sick stomach* or *milk sickness.*

Vol. 2. Description of a new species of Ranunculus (lacustris), by L. C. Beck and James G. Tracy.

Vol. 2. An examination of the question, whether the climate of the valley of Mississippi under similar parallels of latitude is warmer than that of the Atlantic Coast.

Vol. 4. An account of the Small Pox, Varioloid and Chicken Pox, which prevailed at Albany in 1834, with remarks on the identity of these diseases and the protective powers of vaccination.

Vol. 5. An account of the Salt springs at Salina, Onondaga County, New York, with a chemical examination of the water and of the several varieties of salt manufactured at Salina and Syracuse.

Vol. 7. Notice and chemical examination of the mineral water recently discovered in the city of Albany.

Vol. 6. General views of the formation of Phosphuretted hydrogen.

Vol. 7. On the nature of the compounds usually called Chlorids of Soda, Lime, &c., with remarks on their uses as disinfecting agents.

Transactions of the Albany Institute.

Vol. 1. On the Geographical Botany of the United States. Part I.

Silliman's Journal.

Vol. 10. Contributions towards the Botany of the States of Illinois and Missouri.

Vol. 29. Researches on the Commercial Potash of the State of New York.

Vol. 36. Note on the New Brunswick Tornado or Water Spout of 1835.

Vol. 36. Notices of Native Copper, Ores of Copper and other minerals found in the vicinity of New Brunswick, New Jersey.

Vol. 42. Notice of some Trappean Minerals found in New York and New Jersey.

Vol. 45. Remarkable examples of Expansion and Contraction, &c.

Vol. 45. Views concerning Igneous Action, &c.

A Manual of Chemistry, 1831. This work passed through four editions.

Official Report on Cholera, made to Governor Throop, August, 1832. This paper gives a geographical account of its progress in this State, also its fatality, symptoms, &c. It is published in the Transactions of the State Medical Society for 1833, and was reprinted in the Edinburgh Medical and Surgical Journal.

Botany of the Northern and Middle States, arranged according to the Natural System, 1833, and 1848. (Two editions.)

The Natural History of New York—Mineralogy. In 4to. (Official Publication.) This work was preceded by several Annual Reports to the Legislature on the same subject.

Adulterations of various substances used in Medicine and the Arts. 1846.

* This work was edited by his brother, John B. Beck, M.D.

At the request of the Patent Office at Washington, and of Professor Henry of the Smithsonian Institution, Dr. Beck commenced in 1848, a most laborious series of "*Researches on the Bread Stuffs of the United States.*" The Report was subsequently published at Washington.

VII. Bibliography.

1. *A History of the Fishes of Massachusetts;* by David Humphreys Storer, M.D., A.A.S. 90 pp., 4to, with 16 4to lithographic plates.—From the Transactions of the American Academy of Arts and Sciences, vol. v.—Dr. Storer, as one of the Commissioners on the Zoology of Massachusetts in the year 1839, prepared a Report on the Ichthyology of the state, which was published without illustrations. The Memoir, the first part of which is here published, will present a revision of the whole subject, with excellent figures of the species, and a large amount of additional matter. The paper before us includes the following species:

I. *Percidæ.*—Perca flavescens, *Cuv.*, Labrax lineatus, *Cuv.*, L. rufus, *Dekay*, Centropristes varius, *Storer*, Pomotis vulgaris, *Cuv.*, P. appendix, *Dekay.*

II. *Triglidæ.*—Prionotus lineatus, *Dekay*, P. palmipes, *Storer*, P. pilatus, *St.*, Dactylopterus volitans, *Cuv.*, Cottus gracilis, *Heckel*, Acanthocottus variabilis, *Girard*, A. virginianus, G. Boleosoma Olmstedi, *Agassiz*, Aspidophorus monoptergyius, *Cuv.*, Cryptacanthodes (*Storer*) maculatus, Hemitripterus acadianus, *St.*, Sebastes norvegicus, *Cuv.*, Gasterosteus biaculeatus, *Mitchill*, G. quadracus, *Mitchill*, G. Dekayi, *Agassiz.*

III. *Sciænidæ.*—Otolithus regalis, *Cuv.*, Umbrina nebulosa, *St.*

IV. *Sparidæ.*—Sargus ovis, *Cuv.*, Pagrus argyrops, *Cuv.*

V. *Scombridæ.*—Scomber Dekayi, *St.*, Sc. vernalis, *Mitchill*, Pelamys sarda, *Cuv.*, Thynnus secundo-dorsalis, *St.*, Cybium maculatum, *Cuv.*, Trichiurus lepturus, *Lin.*, Xiphias gladius, *Lin.*, Palinurus (*Dekay*) perciformis, *Dek.*, Caranx chrysos, *Cuv.*, Argyreiosus capillaris, *Dek.*, A. unimaculatus, *Batchelder*, Seriola zonata, *Cuv.*, Temnodon saltator, *Cuv.*, Rhombus triacanthus, *Dek.*, Sphyræna borealis, *Dek.*

VI. *Atherinidæ.*—Atherina notata, *Mitchill.*

VII. *Mugilidæ.*—Mugil lineatus, *Mitchill.*

The descriptions of the species are clear and precise, and abound in details, the results of the author's careful investigations; they are accompanied with full lists of synonyms. The plates are remarkably fine, though without anatomical details. When complete, the work will be a thorough exposition of the Ichthyology of the part of our country to which it relates; and as the same species in many instances have a wide range and have relations to those of other regions, it will find readers throughout the land and among all interested in American zoology.

2. *Löwig's Principles of Organic and Physiological Chemistry;* translated by Daniel Breed, M.D., of the U. S. Patent Office.—The systematic character of this work adapts it admirably to the purpose for which it was intended, viz., as an introduction to the study of Or-

ganic Chemistry. It is at the same time a complete compend of all the facts in this department of Science. But its great value lies in its being something more than a mere catalogue of organic compounds; it is a system of organic chemistry as far as such is practicable in the present state of the science. The facts are considered in their relations to each other, and the memory is thus materially assisted in obtaining a survey of the immense field which is presented.

The work is intended as an introduction to a larger one by the same author, which has long been regarded as a standard work in Germany. His system of Organic Chemistry is, however, fully given in the present volume. It may be well to add that a large portion of the work, according to a statement made in the preface, was translated at Zürich under the supervision of the author, which fact will serve as a guarantee of its fidelity to the original. We sincerely hope that the success of this volume will authorize the translator in the execution of his intention to give to the American public Prof. Löwig's larger work on the "Chemistry of Organic Combinations."

3. *Annual of Scientific Discovery, or Year-Book of Facts in Science and Art for* 1853, exhibiting the most important discoveries and improvements in Mechanics, Useful Arts, Natural Philosophy, Chemistry, Astronomy, Meteorology, Zoology, Botany, Mineralogy, Geology, Geography, Antiquities, etc., together with a list of Recent Scientific Publications, a classified list of Patents, Obituaries of Eminent Scientific Men, notes on the Progress of Science during the year 1852, etc., edited by DAVID A. WELLS, A.M. 412 pp., 12mo. Boston, 1853, Gould & Lincoln.

4. *On Coral Reefs and Islands*, by JAMES D. DANA; from the author's Exploring Expedition Report on Geology, with additions. 144 pp. 8vo, with two maps and numerous wood-cuts. New York, 1853. G. P. Putnam & Co.

5. *Report on the Crustacea of the Exploring Expedition under C. Wilkes, U. S. N.;* by JAMES D. DANA. 4to. Part I, 1 to 690 pp., 1852; Part II, 690—1620 pp., with an oceanic Isothermal Chart, 1853. G. P. Putnam & Co., New York City.—The copies of this work on sale are less than 100 in number. The Atlas of 96 folio plates, will be ready in the course of the year.

6. *The Principles of Botany, as exemplified in the Cryptogamia, for the use of Schools and Colleges;* by HARLAND COULTAS. 94 pp., 12mo. Philadelphia, 1853. Lindsay and Blakiston.

7. *Memoirs of the American Academy of Arts and Sciences. New Series.* Vol. V. Part I. 178 pp. 4to. Cambridge and Boston, 1853.

I. W. H. EMORY: Astronomical, Magnetical, and Meteorological Observations, made at Panama, New Granada.

II. WINTHROP SARGENT: Plan of an Ancient Fortification at Marietta, Ohio. (With a Plate.)

III. WALDO J. BURNETT: Researches upon the Origin, Mode of Development, and Nature of the Spermatic Particles among the Four Classes of Vertebrated Animals. (With a Plate.)

IV. DAVID HUMPHREYS STORER, M.D., A.A.S.: A History of the Fishes of Massachusetts. (With Eight Plates.)

V. CHARLES HENRY DAVIS, A.M., A.A.S., M.A.P.S., etc.: A Scientific Account of the Inner Harbor of Boston, with a Synopsis of the

General Principles to be observed in the Improvement of Tidal Harbors.

VI. W. C. Bond: Observations on a New Ring of the Planet Saturn. (With a Plate.)

VII. G. P. Bond: On the Rings of Saturn.

VIII. David Humphreys Storer, M.D., A.A.S.: A History of the Fishes of Massachusetts. Part II. (With Eight Plates.)

IX. Henry L. Eustis, A.M.: The Tornado of August 22d, 1851, in Waltham, West Cambridge, and Medford, Middlesex County, Mass. (With a Map.)

North-Western Medical and Surgical Journal; edited by Prof. W. B. Herrick, M.D., of the Rush Medical College, etc., and H. A. Johnson, A.M., M.D.; published monthly in numbers of 80 8vo pp. $2 per annum.—May, 1853, Vol. II. No. 1.

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T. Poesche and C. Goepp: The new Rome or the United States of the World.—180 pp., 12mo. *New York*, 1853. G. P. Putnam & Co.

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R. T. Lowe, M.A.: Primitiæ et Novitiæ Faunæ et Floræ Maderæ et Portus Sancti: Two memoirs on the Ferns, Flowering Plants and Land Shells of Madeira and Porto Santo. Reprinted from the Trans. Camb. Phil. Soc. 12mo. *London*, 1851.

M. P. H. Maille: Nouvelle Théorie des Hydrométéores, suivie d'un Mémoire sur l'électricité atmosphérique et d'un autre sur la pluviomètre. 368 pp., 8vo. *Paris*, 1853. Bachelier.—This work will much interest meteorologists, although there may be a difference of opinion as to the views sustained. The author's theory is in many points similar to that of Mr. Espy, and he claims the priority. As we have not space to do justice to the author's views, we can only commend the volume to those who wish to examine into the rival theories in Meteorology.

H. W. Dove: Die Verbreitung der Wärme auf der Oberfläche der Erde. 26 pp., 4to, with 7 Charts and 2 Temperature Tables. 2nd edit., enlarged. *Berlin*, 1852.

Proceedings of the Acad. Nat. Sci. Philadelphia. Vol. VI, No. 8.—p. 303. New Fossil bear from Natchez, Miss., Ursus amplidens; *J. Leidy.*—p. 304. Notes on the Ornithology of Wisconsin; *P. R. Hoy.*—p. 313. On a section across the continent of S. America, showing the barometric pressure; *Lieut. Maury.*—p. 316. Monograph of the genus Fulgur, with descriptions of fossil species; *T. A. Conrad.*—Catalogue of the Oological collection in the Academy; *A. L. Heermann.*

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